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ABSTRACTS

of recent published material on
Soil and Water Conservation

Number 40

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UNITED STATES DEPARTMENT OF AGRICULTURE

The "ABSTRACTS of recent published material on Soil and Water Conservation" are issued at irregular intervals. Their purpose is to bring together a summary of current published information about soil and water conservation work. Reprints of abstracted articles are generally not available in the Soil and Water Conservation Research Division. Request for reprints should be sent to the authors or institutions; addresses are appended.

The classification of articles follows the table of contents used for the "Soil and Water Conservation Research Needs" of the Soil Conservation Service. Abstracted articles are not editorialized and the language of the author is used wherever possible. In foreign articles, the units of measure are converted to usual American units. Tables are included where they help to present the information. When the entire number of a publication is devoted to reviewing one subject then the entire publication is abstracted as one article giving title and authors of each paper included in the publication. Abbreviations of journals and addresses follow U.S.D.A. Misc. Pub. 765, July 1958.

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Charles B. Crook, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, Plant Industry Station, Beltsville, Md. 20705.

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WATERSHED ENGINEERING

Watershed Development

See Also 9, 10, 13, 18, 255, 304, 309, 310, 311, 338.

1. Anonymous. COMPREHENSIVE RIVER BASIN PLANNING. J. Soil and Water Conserv. 19(4): 133-146. 1964.

Planning to meet the people's needs for water and land resources, an effort begun shortly after the birth of the Union, has taken on new dimensions with the advent of new inter-agency efforts to improve the ground rules and guidelines.

The three articles in this special series traced the development of concepts and standards, described the role of agriculture, and delineated economic consideration in river basin planning. The following articles were presented:

2. Weber, E. W. DEVELOPMENT OF A CONCEPT. Chief Engineers, U.S. Dept. Army, Washington, D. C.
3. Young, G. E. THE ROLE OF AGRICULTURE. SCS, USDA, Washington, D.C. 20250
4. Green, W. A. ECONOMIC CONSIDERATIONS. RDED, ERS, USDA, Washington, D.C. 20250

Hydrology

See Also 11, 14, 16, 230, 235.

5. Ibrahim, H. A., and Brutsaert, W. INFLOW HYDROGRAPHS FROM LARGE UNCONFINED AQUIFERS. J. Irrig. and Drain. Div., ASCE 91 (IR 2): 21-38. June 1965.

A general method was presented for predicting the subsurface lateral inflow hydrography from large unconfined aquifers into adjacent streams. It was based on grouping the pertinent variables into dimensionless parameters. The relationships between these parameters were obtained experimentally. Use was made of the analogy between the flow of water through a saturated porous medium and the flow of a viscous fluid in a Hele-Shaw model. The experimental results verified the applicability of the proposed method. Field problems with similar boundary conditions may be solved through the use of simple transformation equations. A comparison was presented between the experimental results and some of the approximate solutions available in the literature.

Jr. Author, Cornell U., Ithaca, N.Y. 14850

6. Hammad, H. Y. NATURAL DRAINAGE OF RIVER VALLEYS. J. Irrig. and Drain. Div., ASCE 91 (IR 2): 39-49. June 1965.

The problem of seepage flow from a river into its valley deposits and vice versa was examined. The valley aquifer is formed of a sand bed topped by a clay cap. If lift irrigation is applied to the valley land, the river water being lower, the river itself may behave as a natural drain to which the excess of irrigation water seeps through the permeable valley deposits. The propagation of a pressure wave in the valley aquifer resulting from a flood wave in the river was studied and water-table fluctuations were determined with the object of fulfilling both drainage requirements, namely, drawdown and leaching. The proposed treatment was applied to the case of the Nile Valley (Egypt) in the pre- and post-high-dam conditions. The adequacy of the natural drainage process was examined.

Alexandria U., Egypt, U.A.R.

7. Witherspoon, D. F. RUNOFF FROM RAINFALL ON SMALL RURAL WATERSHEDS. Engin. Inst. Canada Trans. 6 (A 10): 1-7. 1963.

A graphical relation was presented which is useful in estimation of runoff volumes from small agricultural areas in Ontario. The parameters used in the relation are antecedent precipitation index, effective rainfall duration soil cover conditions, and effective rainfall depth. The mean error of estimate of runoff depth was 0.05 inches on areas up to 1 square mile of a medium-textured soil.

Dept. Northern Affairs and Natl. Resources, Cornwall, Ontario, Canada.

8. Berndt, H. W. SNOW ACCUMULATION AND DISAPPEARANCE IN LODGEPOLE PINE CLEARCUT BLOCKS IN WYOMING. J. Forestry 63(2): 88-91. 1965.

In the Big Horn Mountains in Wyoming, clear-cutting mature lodgepole pine in blocks of 5, 10, and 20 acres increased peak snow accumulation over that of uncut stands. Greatest response to clear-cutting was found in the east aspect. Greatest influence of clearcut block size on snow accumulation occurred on the south aspect. On south and east aspects, snow disappearance was similar on all clearcut blocks.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo. 80521

9. Osborn, H. B. EFFECT ON STORM DURATION ON RUNOFF FROM RANGELAND WATERSHEDS IN THE SEMIARID SOUTHWESTERN UNITED STATES. Internat'l. Assoc. Sci. Hydrol. 9(41): 40-47. Dec. 1964.

Almost all runoff from the semiarid rangelands of Southwestern United States results from intense convective storms of short duration. Depth-duration values for precipitation for this region that are developed through standard procedures may be misleading when used for runoff design. Various combinations of short bursts of rain can, and do, plot on average depth-duration curves, but such curves have little practical meaning for small watersheds (100 square miles or less).

For design purposes for small watersheds, depths of precipitation for relatively short periods (15, 30, or 60 minutes) for varying return periods and areas are needed. For runoff design for larger watersheds two probability estimates may be needed--the probability of storms of certain intensities and size falling on tributary watersheds of finite sizes and the probability of storms developing over a multi-tributary system in such patterns as to produce important volumes and peaks of runoff.

SWCRD, ARS, USDA, Tucson, Ariz. 85717

Geology

See Also 6, 15, 17, 145, 146, 148.

10. Jones, B. L. CONSERVATION EFFECTS IN A SMALL WATERSHED. J. Soil and Water Conserv. 20(3): 26-28. 1965.

Preliminary results were given from an investigation on the effects of conservation practices on runoff and sedimentation characteristics of small watersheds in northern Pennsylvania.

Analysis of data collected during the 1955-1960 period indicated that conservation practices have affected the rate of sediment discharge from the Corey Creek watershed, although runoff characteristics have not changed significantly. The overall trend has been toward decreasing sediment yield, but a temporary sharp increase was observed between August 1955 and May 1958. This period corresponded to the period of most intense construction of terraces within the basin.

Most of the change in sediment discharge occurred during the May-October growing season; little or no change occurred during the November-April dormant

season. Many of the conservation practices were aimed at higher crop yields and better use of specified acreage, and were applied more extensively during the growing season.

In an average year, three-quarters of the annual sediment discharge occurred during the dormant season. There would appear to be definite advantages in placing more emphasis on soil conservation practices that are effective during the dormant season. Such emphasis might involve increasing the acreage and quality of dormant-season vegetal cover, drainage improvement, and application of other engineering practices.

Geol. Survey, Dept. Int., Harrisburg, Pa.

11. Striffler, W. D. SEDIMENT, STREAMFLOW, AND LAND USE RELATIONSHIPS IN NORTHERN LOWER MICHIGAN. U.S. Forest Serv. Res. Paper LS-16, 12 pp. 1964.

In the Tobacco River of northern Lower Michigan, both streamflow variability and sediment discharge rates were related to land use. Cultivated and pasture lands, which received annual disturbance in the form of plowing or grazing and which were largely confined to finer textured till plain soils, demonstrated extreme variability in both stream discharge rates and sediment discharge rates. On the other hand, forest and wild lands, which were comparatively undisturbed and which were generally associated with coarse-textured soils, had unusually stable stream discharge rates and were relatively low sediment contributors.

These relationships were determined for the Tobacco River Watershed by means of a multiple regression analysis of sediment and streamflow observations taken from 20 sample watersheds each representing varying conditions with respect to land use and degree of bank erosion. Results were summarized as follows:

1. Cultivated land occupying 10 percent of the watershed and with an average sediment yield rate of 2,200 lb./day/sq.mi. contributed 15 percent of the average observed suspended sediment load.
2. Wild land was the lowest sediment contributor of all land-use types, contributing about 5 percent from 26 percent of the area. The average sediment yield rate was 74 lb./day/sq.mi.
3. Forest land contributed 23 percent of the average sediment load from 44 percent of the area. The average sediment yield rate from a forested watershed was about 360 lb./day/sq.mi.
4. About one-third of the average suspended sediment load was attributed to eroding banks.

North Central Expt. Sta., FS, USDA, St. Paul, Minn. 55101

12. Miller, C. R., and Bowie, A. J. SEDIMENT SAMPLING: INSTRUMENTATION AND TECHNIQUES. Trans. ASAE 8(2): 267-270, 274. 1965.

The various instruments and techniques currently employed by the U.S.D.A. Sedimentation Laboratory to sample sediment discharge were described. Although improvements in existing sampling equipment and techniques are constantly being made and new devices for sediment sampling and concentration sensing are being developed, major problems associated with accurate determination of total sediment movement and measurement of sediment discharge on rapid rising streams and at remote locations remain unsolved.

A variety of methods to improve and automate sediment sampling are currently under investigation by the Federal Inter-Agency Sedimentation Project. The U.S.D.A. Sedimentation Laboratory continues its efforts to improve sediment-sampling techniques and procedures including the adaptation of electronic, ultrasonic, photoelectric, and capacitance processes. At present, the radioisotope means of sediment concentration sensing and the development of various pumping-type samplers seem to offer the best possibility for improved sediment discharge determinations. Continuing research should provide guides and methods for combining field sediment-sampling results with stream hydraulics and sediment characteristics in the development of methodology for determining total sediment discharge.

Jr. Author, SWCRD, ARS, USDA, Holly Springs, Miss. 38635

13. Baird, R. W. SEDIMENT YIELDS FROM BLACKLAND WATERSHEDS. Trans. ASAE 7(4): 454-456. 1964.

The effect of land use and conservation practices on sediment yields is an important consideration in the evaluation of conservation practices and in the design of floodwater detention structures. A report was given of a continuing study at the Blacklands Experimental Watershed near Riesel, Tex., to measure runoff and sediment concentration from two watersheds--one with conservation practices and the other without. The comparison required the development of a method of calculating sediment yield for prediction purposes.

The order of magnitude of the effect of specific changes in land-use and conservation practices on sediment yield was reported along with the relations between soil losses and sediment yields under the two treatments. For the Blacklands area, the effect was primarily the reduction of sediment concentration with only a limited effect on the amount of runoff or distribution of runoff in various rate classes.

SWCRD, ARS, USDA, Temple, Tex. 76502

14. Bittinger, M. W., and Trelease, F. J. DEVELOPMENT AND DISSIPATION OF A GROUND-WATER MOUND. Trans. ASAE 8(1): 103-104, 106. 1965.

The development and dissipation of a ground-water mound beneath a spreading basin may be computed by the use of equations previously derived for heat conduction and other problems in physics. Comparisons between field observations and computed water-table rises due to artificial recharge from a spreading basin in an alluvial aquifer in eastern Colorado showed the possibilities of predicting the influence of recharge so that proper design and location of recharge projects could be accomplished. The study showed that a knowledge of the aquifer properties was required in order to predict recharge effects accurately. For distances of observation greater than 2.5 times the radius of the spreading basin, the source of recharge could be considered a recharge well rather than a disk source, and the Theis non-equilibrium equation could be used.

Colo. Agr. Expt. Sta., Fort Collins, Colo. 80521

Engineering Design

See Also 5, 12, 68.

15. Bishop, A. A., Simons, D. B., and Richardson, E. V. TOTAL BED-MATERIAL TRANSPORT. J. Hydraul. Div., ASCE 91 (HY 2): 175-191. 1965.

A method of estimating the bed-material discharge of sand-bed flumes, canals, and rivers was presented. The method uses a group of curves developed from flume data that relate intensity of transport, intensity of shear, and the median fall diameter of the bed material. Also, these curves illustrate that the intensity of transport varies with regime of flow and form of bed roughness. Application of the method yielded good results for sand-bed channels when the depth of flow was less than 4 feet.

Utah U., Logan, Utah. 84321

16. Yevdjovich, V. M. BIBLIOGRAPHY AND DISCUSSION OF FLOOD-ROUTING METHODS AND UNSTEADY FLOW IN CHANNELS. U.S. Geol. Survey, Water Supply Paper 1690, 235 pp. \$1.00 1964.

Several methods of channel flood routing are in use. Considerable disagreement on flood-routing methods exists between agencies, and much time is being spent in an attempt to improve these methods or to develop new ones. A survey of published literature on the subject is needed to eliminate loss of time and to increase efficiency of studies now in progress. A cooperative project was initiated to prepare a bibliography of literature on channel routing and a commentary on the

various methods. No attempt was made to single out one particular method for universal use; however, the compilations and comments indicate the inutility of some methods and establishes the limits of application of those that can be used.

A general discussion of unsteady flow in channels and the present status of flood-routing methods were given along with a bibliography of domestic and foreign literature. The bibliography was arranged chronologically and contains abstracts of 844 papers that were published within the time limits of the project; items were indexed by authors and by subjects.

For sale by Supt. Doc., U.S. Govt. Print. Off., Washington, D.C. 20402

17. Seed, H. B. SETTLEMENT ANALYSES, A REVIEW OF THEORY AND TESTING PROCEDURES. J. Soil Mechanics and Found Div., ASCE, 91(SM 2): 39-48. 1965.

A review was presented of major developments influencing the conduct, in engineering practice, of settlement analyses for buildings on saturated clays. Beginning with Terzaghi's theory of consolidation, the significant guidelines to this study were delineated. Within this framework, contributions to the ASCE Conference on Design of Foundations for the Control of Settlement were examined. Even in this barest outline, a number controversial issues were noted. A great need exists for field data and research investigations in the settlement of foundations on sands and partially saturated clays.

U. Calif., Berkeley, Calif. 94720

18. Burroughs, E. R., Jr., Hughes, S. P., Hicks, B. L., and Haupt, H. F. GEOPHYSICAL EXPLORATION IN WATERSHED STUDIES. J. Soil and Water Conserv. 20(3): 3-7. 1965.

Measurements of seismic wave velocity and electrical resistivity in materials below the earth's surface can provide much valuable information about subsurface conditions. These geophysical exploration methods can be highly useful in conducting watershed investigations, and they are relatively inexpensive. Either method can be used by two men, but a three-man crew is optimum for making measurements of electrical resistivity. Since this equipment can be carried easily by crew members, problem areas can be explored quickly with a minimum of exhausting hand labor.

Trained and experienced personnel are needed to operate the equipment and interpret field data. Usually, a survey of the areal geology by an experienced operator will be helpful in interpreting the field data. Agencies and firms having suitable equipment and qualified personnel can be employed to conduct geophysical investigations with electrical resistivity and seismic refraction measurement techniques.

Intermountain Forest and Range Expt. Sta., FS, USDA, Moscow, Idaho. 83843

Snow Surveys

See Also 8.

19. Farnes, P. E., and Cook, S. E. FEDERAL-STATE-PRIVATE COOPERATIVE SUMMARY OF SNOW SURVEY AND SOIL MOISTURE MEASUREMENTS FOR MONTANA; INCLUDING PERTINENT MEASUREMENTS IN ALBERTA, SASKATCHEWAN, BRITISH COLUMBIA, IDAHO, AND WYOMING, 1922-1964. Fed.-State-Private Coop. Snow Surveys 1922-64. 217 pp. 1964.

This is the third summary of Montana snow survey measurements to be published since surveys were started in 1922 and is the first to include soil moisture data. Other summaries were issued in 1953 and 1958. This supersedes all previous Montana summaries.

Data shown in this report include date survey was made, depth of snow in inches, and snow water equivalent in inches. Soil moisture measurements show date of survey and total amount of water within the profile depth in inches.

Soil Survey Supervisor, SCS, USDA, Box 855, Bozeman, Mont. 59715

See 73.

WATER MANAGEMENT

Irrigation

See Also 41, 54, 59, 69, 71, 73, 93, 119, 129, 130, 132, 151, 185, 194, 197, 199, 213, 228, 233, 277, 281, 290, 345.

20. Korven, H. C., and Wilcox, J. C. CORRELATION BETWEEN EVAPORATION FROM BELLANI PLATES AND EVAPOTRANSPIRATION FROM ORCHARDS. *Canad. J. Plant Sci.* 45(2): 132-138. Mar. 1965.

The balance-sheet method, keeping an account of evapotranspiration (estimated from evaporation as measured by Bellani plates) and rainfall, was used for scheduling irrigations on a practical field basis on five orchards in Summerland, B.C. Undertree sprinkler irrigation with 12-hour sets, the common method in the Okanagan Valley, was used. Soil moisture deficits were measured by the gravimetric method and estimated from the balance-sheet records. Highly significant positive correlations were obtained between the measured and the estimated deficits. The standard error of regression was high, about 20 percent of the mean. In spite of this, the balance-sheet method proved to be quite satisfactory for use in practical scheduling of irrigation in orchards.

Expt. Farm, Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

21. Namken, L. N. RELATIVE TURGIDITY TECHNIQUE FOR SCHEDULING COTTON (Gossypium hirsutum) IRRIGATION. *Agron. J.* 57(1): 38-41. 1965.

Cotton was irrigated when the relative turgidity of the plant leaves sampled between 2:30 and 3:00 p.m. reached the 70 to 72 percent, 64 to 66 percent, and 60 to 62 percent ranges, respectively. Cotton plants exhibited visible wilt symptoms at approximately 72 percent relative turgidity, but they were able to endure short periods of severe plant moisture stress (66 to 62 percent relative turgidity) without significant yield reductions. Long periods of moderate to severe plant moisture stress (70 to 62 percent relative turgidity) during the bloom stage of plant growth caused significant yield reductions. There was no significant yield reduction when the average relative turgidity of cotton plant leaves was 72 percent or higher during the bloom.

SWCRD, ARS, USDA, Weslaco, Tex. 78596

22. Rumburg, C. B., and Sawyer, W. A. RESPONSE OF WET-MEADOW VEGETATION TO LENGTH AND DEPTH OF SURFACE WATER FROM WILD-FLOOD IRRIGATION. *Agron. J.* 57(3): 245-247. 1965.

Wet meadow vegetation was subjected to wild-flood irrigation with water 2.5, 4.0, and 7.5 inches above the soil surface for 25, 50, and 75 days. The two dates of irrigation began on April 6 and 20. Three plots randomly placed in each of three replications, received no surface irrigation but the water applied to the irrigated plots brought the water table up to the soil surface so that these soils were saturated during the experimental period. The experiment was conducted over a 3-year period.

Hay yields increased with increasing lengths of irrigation except when the surface water was 7.5 inches deep. Delaying the beginning of irrigation from April 6 until April 20, with a comparable extension at the end of the season, increased hay yields by 0.25 ton/acre. Increasing the length of flood increased rush yields and decreased yields of sedge and "other species." The treatments had no measurable effect on grass yields.

The greatest yields of hay from native wet meadows was obtained with long, continuous wild-flood irrigation. Ponding of water above the soil surface was not detrimental to yield unless it reached depths greater than 5 inches and persisted for long periods of time.

Nitrogen content increased with increasing lengths and depths of water. A significant correlation coefficient (0.446) was found between nitrogen content and percent rushes. However, only about 20 percent of the variation in nitrogen was accounted for by variation in rush composition.

CRD, ARS, USDA, Squaw Butte Expt. Sta., Burns, Oreg.

23. Smerdon, E. T., and Glass, L. J. SURFACE IRRIGATION WATER-DISTRIBUTION EFFICIENCY RELATED TO SOIL INFILTRATION. TRANS. ASAE 8(1): 76-78, 82. 1965.

The results of the theoretical and laboratory investigations on surface irrigation water-distribution efficiency as related to soil infiltration indicated that:

1. The principle of electrophoresis can be successfully utilized in removing kaolin and bentonite from suspension.
2. The theoretical removal of colloid from suspension differed from the experimental values in most cases. These differences may be attributed to the assumed electrical charge of the clay particles or to possible discrepancies in the single-particle approach in the theory.
3. For a given influent concentration of suspension, the effluent concentration increased with an increasing flow rate of suspension through the system.
4. Except for bentonite at a field strength of 250 volts per centimeter, effluent concentration decreased as electric field strength increased.
5. Electrolysis of water molecules and heat transfer losses caused a reduction in efficiency of turbidity removal at high electric field strengths.
6. The efficiency of removal of colloids from suspension decreased with an increase in deposition of clay on the rod (anode).
7. More clay was deposited near inlet and outlet ends of the rod than in the central portion.
8. The percentage removal of kaolin and bentonite colloids from suspension was not statistically different at the 99 percent level.
9. The electrokinetic system can be cleaned by reversal of flow of the electric current through the system.

Water Res. Inst., Tex. A&M U., College Station, Tex. 77841

24. Pair, C. H. A COMPARISON OF WATER APPLICATION EFFICIENCIES OBTAINED UNDER VARIOUS METHODS OF APPLYING IRRIGATION WATER. Proc. Alaskan Sci. Conf. 14: 125-126. 1964.

A study conducted near Boise, Idaho, compared the field water application efficiency of the furrow, border, contour border, and sprinkler methods of irrigation on alfalfa and hard fescue grass crop grown on 3 to 5 percent slopes. The field water application efficiency on the downslope furrow method averaged 40 percent, the downslope border averaged 47 percent, the contour border 66 percent, and the sprinkler method averaged 61 percent. These efficiencies were much higher than the 19 to 33 percent values normally attained by farm operators in the area.

Maximum water application efficiency required water control equipment, proper land preparation, correct irrigation system design, and proper management of the irrigation system. With all other factors favorable, these practices should result in maximum production of a quality crop.

SWCRD, ARS, USDA, Twin Falls, Idaho. 83843

25. Hart, W. E., and Reynolds, W. N. ANALYTICAL DESIGN OF SPRINKLER SYSTEMS. Trans. ASAE 8(1): 83-85, 89. 1965.

The interrelationships between sprinkler-water distribution, water made available to the plant, water lost through deep seepage, and water deficits within the areas irrigated by sprinklers were discussed in the light of an assumed normal distribution of overlapped pattern values. It was demonstrated that related parameters can be used for evaluating the expected performance from a proposed installation. If the designer is favored with a suitable explicit relationship between crop yield and water made available to the plant, he can carry his analysis to an estimate of production.

U. Calif., Davis, Calif. 95616

26. Humpherys, A. S., and Lauritzen, C. W. HYDRAULIC AND GEOMETRICAL RELATIONSHIPS OF LAY-FLAT IRRIGATION TUBING. U.S. Dept. Agr., Agr. Res. Serv. Tech. B. 1309, 38 pp. 1964.

Lay-flat tubing lies flat when empty like a deflated innertube section. The tubing is usually made from such materials as butyl rubber or plastic in which a supporting fabric is often built into the walls to impart additional strength.

It is often feasible in irrigation practice to replace farm ditches and laterals with lay-flat tubing, particularly in areas where seepage and erosion are problems.

The hydraulic design was given of a water distribution system where lay-flat tubing was used. The principal objectives were: (1) To obtain data from static head measurements from which the tube pressure-area-shape relationships could be determined; and (2) to determine a shape factor that would express the effect of cross-sectional shape upon the frictional head loss and allow conventional pipe design formulas to be modified and used for lay-flat tubing.

For the static tests, the hydraulic properties of lay-flat irrigation tubing were closely related to the shape and cross-sectional area of the tube. These characteristics were in turn dependent upon the fluid pressure head inside the tube. A study was undertaken to obtain data from which the pressure-shape-area relations could be determined. The cross section of tubing at various hydrostatic pressure heads was traced with a special pantograph. Tracings were made of supported polyvinyl chloride plastic and butyl rubber tubes of different diameters. The area of the cross-sectional tracings was measured and related to the hydrostatic head, tube height, width, height-width ratio, and height-width product.

The cross-sectional area of tubing 4 to 16 inches in diameter for different degrees of tubing roundness was determined and was presented in table form.

Diagrams relating the discharge for irrigation tubing of different diameters and degrees of roundness to the head loss were presented.

Photographs, charts, and tables.

ARS, USDA, Inform. Div., FCB, Hyattsville, Md. 20782

27. Dixon, R. M., and Peterson, A. E. CONSTRUCTION AND OPERATION OF A MODIFIED SPRAY INFILTRMETER AND A FLOOD INFILTRMETER. Wis. Agr. Expt. Sta., Res. Rpt. 15, 31 pp. 1964.

A spray-type infiltrometer was developed at Purdue University for studying infiltration of water into soils under various soil and vegetative conditions. The original design objectives of the Purdue infiltrometer included: Portability; practicality; reproducibility; economy of construction; ease of installation and operation; and shortness of time required for individual runs.

A number of modifications and refinements of the Purdue sprinkler infiltrometer were described, which are in accord with the original design objectives. Most components of the infiltrometer were redesigned; however, the basic features (nozzle type; height and pressure; and plot size) were retained. The modifications were desirable since they: (1) Increased reproducibility of duplicate runs; (2) reduced the cost of fabrication and maintenance; and (3) reduced the labor required for installation and operation.

Past research has shown that soil crusting or sealing exerts a profound influence on water intake into the soil and thus is an important aspect of soil

management. Since the advent of herbicides, many new soil management practices have been developed which, differ greatly in their ability to resist surface sealing. As there is no quick, direct method for evaluating this ability to resist surface seal, there is a need for a soil and water conservation index (or parameter) for soil surface management.

To meet this need, construction of a flood-type infiltrometer was undertaken to be used in conjunction with the spray-type infiltrometer. The surface management index is in the form of a ratio between infiltration as measured by the spray infiltrometer and infiltration as determined with the flood infiltrometer under a standard set of conditions. The nearer this ratio approaches 1, the better the surface management for a particular soil.

Both of the infiltrometers were described and illustrated.

Agr. Expt. Sta., U. Wis., Madison, Wis. 53706

28. Keller, J. SELECTION OF ECONOMICAL PIPE SIZES FOR SPRINKLER IRRIGATION SYSTEMS. Trans. ASAE 8(2): 186-190, 193. 1965.

A new and efficient method was developed for arriving at a direct economic solution for the pipe size selection of simple single mainlines which are not on steep downhill slopes or powered by variable-speed power units.

Discrete adjustments were discussed and sample problems were given for: Sub and branch mainlines; steep downhill mainlines; and mainlines connected to variable speed pumping plants. The strength of the direct economic approach was demonstrated by the exactness and ease of handling both single and multiple adjustments.

The concepts presented should cover most mainline design problems. The new method can be readily applied by the design engineer and will lead to a more efficient, complete, and economical design of sprinkler systems.

Utah Agr. Expt. Sta., Logan, Utah. 84321

29. Wilcox, J. C. TIME OF SAMPLING AFTER AN IRRIGATION TO DETERMINE FIELD CAPACITY OF SOIL. Canad. J. Soil Sci. 45(2): 171-176. June 1965.

Drainage curves following irrigation were determined at six depths in eight soils having unrestricted drainage but varying widely in soil texture. The field capacities were determined under relatively high rates of evapotranspiration. The time after irrigation that it was necessary to wait before sampling the soil, to determine field capacity, was also determined. A high positive correlation was obtained between the log of field capacity in inches and the log of time after irrigation at which to sample the soil. The time varied from about 0.5 day with 1.5 inches field capacity to 4.0 days with 35 inches. From the curves of soil moisture content versus time, the errors caused by sampling too soon or too late were determined. The percentage error (i.e., percent of field capacity) increased with an increase in the error in time of sampling; it decreased with an increase in field capacity in inches; and it was greater when sampling was too soon than when it was too late.

Res. Sta., Canada Dept. Agr., Summerland, British Columbia, Canada.

30. Hough, H. W., and Painter, L. I. EFFECTS OF CORN POPULATION AND NITROGEN FERTILIZATION ON ECONOMICAL PRODUCTION OF CORN SILAGE IN WYOMING. Wyo. Agr. Expt. Sta. B. 412, 16 pp. 1964.

The effects were determined of plant populations and of nitrogen-fertilization rates on corn-silage production in three irrigated regions of Wyoming. An appraisal was also made of the costs and returns expected with different combination of nitrogen fertilization and plant population in each of the areas. It was concluded that:

1. Application of nitrogen fertilizer increased both the yield and the crude-protein percentage of silage harvested from all three populations used, but affected the ear-weight proportions only in the 25,000- and 35,000-plant populations.

2. Plant populations of 15,000, 25,000, and 35,000 plants per acre caused significant differences in silage yields per acre and in ear-weight proportions of harvested silage for any given rate of nitrogen application.
3. Comparisons of added returns minus added costs for the three trial areas at three different prices for field-run silage indicated the most profitable rates of nitrogen applications used with each of three plant populations were as shown in the following table.

TABLE

MOST PROFITABLE NITROGEN-APPLICATION RATE (LB N/A)

LOCATION	PRICE DOLLAR/TON OF FIELD-RUN SILAGE	PLANT POPULATIONS PER ACRE		
		15,000	25,000	35,000
POWELL	4.00	80	80	120
	6.00	120	160	160
	8.00	160	160	160
RIVERTON	4.00	80	120	120
	6.00	120	160	160
	8.00	120	160	160
TORRINGTON	4.00	120	160	160
	6.00	160	200	160
	8.00	160	200	160

U. Wyo., Agr. Expt. Sta., Laramie, Wyo. 82071

31. Benoit, G. R., Hatfield, A. L., and Ragland, J. L. THE GROWTH AND YIELD OF CORN. III. SOIL MOISTURE AND TEMPERATURE EFFECTS. Agron. J. 57(2): 223-226. 1965.

Irrigation responses varied from an average induced increase of 55 percent in 1962 to an average increase of 9.6 percent in 1963. The magnitude of these increases was concluded to be a result of the moisture and temperature regimes under which the plant grew. Low temperatures in 1963 seemed to cause yield levels for unirrigated plots to be higher than in 1962, while the same temperatures caused a decrease in the irrigated yields of 1963 as compared to those of 1962. Thus, temperature moisture level interactions must be considered in evaluating irrigation responses and should be a definite factor in irrigation need and timing.

Low yields associated with late plantings are not primarily a matter of late season drought in humid regions. Lower average air temperature of some associated factor during the ear formation period of late-planted corn seems to be responsible for the lower yield.

U. Ky., Lexington, Ky. 40506

32. Klages, M. G., and Ryerson, D. E. EFFECT OF NITROGEN AND IRRIGATION ON YIELD AND BOTANICAL COMPOSITION OF WESTERN MONTANA RANGE. Agron. J. 57(1): 78-81. 1965.

Fertilizer and water treatments were applied to native range for 3 years. During this time both treatments increased yield but did not affect botanical composition. After 2 dry years, the residual effects of both treatments changed botanical composition, resulting in reduced yield from water and an increase in undesirable species from fertilizer.

Montana State Col., Agr. Expt. Sta., Bozeman, Mont. 59715

33. Cannell, G. H., Bingham, F. T., and Asbell, C. W. EFFECTS OF IRRIGATION AND PHOSPHORUS ON PRODUCTION OF FIELD TOMATOES. Agron. J. 57(2): 176-179. 1965.

In a 2-year irrigation-phosphorus study, the highest tomato fruit yields were associated with a medium moisture treatment and adequate phosphorus. Fruit size decreased significantly with increasing soil suction but it was not increased with higher phosphorus levels. The number of fruit per acre was significantly less in the relatively wet soil moisture treatment when compared to a medium or relatively dry treatment. Fruit rot was increased with decreasing soil suction and was closely related to the number of irrigations.

Col. Agr. and Citrus Res. Cent. and Agr. Expt. Sta., Riverside, Calif. 92502

34. Rumery, M. G. A., Ramig, R. E., and Somerhalder, B. R. IRRIGATED BROMEGRASS, INTERMEDIATE AND TALL WHEATGRASS PASTURES FOR DAIRY COWS. Nebr. Agr. Expt. Sta. B. SB-484, 11 pp. 1964.

Lactating Holstein cows grazed, in rotation, irrigated pastures of pure stands of bromegrass (Bromus inermis), intermediate wheatgrass (Agropyron intermedium), and tall wheatgrass (Agropyron elongatum) during 1956-58. Grain and alfalfa hay were fed as supplemental feed.

Daily milk production per cow was 33.3, 32.9, and 32.6 pounds of 4 percent fat-corrected milk (FCM), respectively, when the cows grazed bromegrass, intermediate wheatgrass, or tall wheatgrass pastures. Differences between these daily milk productions were not significant.

Cows that grazed bromegrass pasture and ate supplemental feed averaged 9,890 pounds of 4 percent FCM per acre. Cows that grazed intermediate wheatgrass produced 9,276 pounds and those that grazed tall wheatgrass produced 6,818 pounds per acre.

Daily gain per cow in live body weight was 0.34, 0.92, and 2.30 pounds, respectively, when the cows grazed bromegrass, intermediate wheatgrass, or tall wheatgrass pastures.

Bromegrass produced more cow days of grazing during May, July, and September, but less in June than did the two wheatgrasses. Pastures of irrigated bromegrass, intermediate wheatgrass, and tall wheatgrass produced 292, 222, and 165 cow days of grazing per acre per year, respectively.

The stand of bromegrass thickened during the 3 years of the experiment, but stands of intermediate wheatgrass died. The stands of tall wheatgrass were seriously reduced. Stands of wheatgrasses could not be maintained under the system of irrigation pasture management used.

All three grasses were readily grazed in pure stands.

U. Nebr. Col. Agr., Agr. Expt. Sta., Lincoln, Nebr. 68503

35. Herron, G. M., and Erhart, A. B. VALUE OF MANURE ON AN IRRIGATED CALCAREOUS SOIL. Soil Sci. Soc. Amer. Proc. 29(3): 278-281. 1965.

Each ton of high-quality manure was equivalent to 22 lb. of nitrogen from ammonium nitrate as measured by equivalent grain sorghum (Sorghum vulgare Pers.) yields over a 4-year period. Phosphorus level of the soil by the Bray and Kurtz no. 1 procedure was increased by 1 p.p.m. for each ton of applied manure. Commercial phosphorus fertilizer did not increase grain yields. Total N content of the surface soil was increased by all manure treatments. Nitrogen uptake by grain was correlated with relative yield of grain. The forage portion of sorghum appeared to take up N in excess of needs for maximum grain yield.

Kan. Agr. Expt. Sta., Kans. State U., Manhattan, Kans. 66504

36. Wehrly, J. S., Sletten, W. H., and Jensen, M. E. ECONOMIC DECISIONS IN PRODUCING IRRIGATED GRAIN SORGHUM ON THE NORTHERN HIGH PLAINS OF TEXAS. Tex. Agr. Expt. Sta. Misc. P. 747, 12 pp. 1964.

The amounts of nitrogen and irrigation water to use in the production of grain sorghum on the Northern High Plains of Texas were studied. There was a strong interacting effect between these two inputs; each was dependent on the presence of the other for much of the yield response from its use.

The experiment was designed to study some of the physiological phenomena of production. The data were not sufficient for a complete economic analysis and were not typical of commercial production situations. The decision-making process necessary for determining the optimum combination of inputs for any price situation were illustrated.

The report was organized into the following three sections: (1) An outline of the economic procedures used; (2) data from research plots to illustrate the type of decisions that a farmer should make to obtain maximum profit; and (3) limitations on applying experimental results to actual farming situations.

Tables and charts.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843

37. Hughes, W. F. LABOR REQUIREMENTS AND COSTS FOR SPRINKLER IRRIGATION, TEXAS HIGH PLAINS. Tex. Agr. Expt. Sta. Misc. P. 750, 16 pp. 1964.

On the High Plains, sprinkler irrigation is used in situations where generally it is not feasible to distribute water by gravity flow. Because of the investment cost associated with sprinkler irrigation and the power required to pump and develop pressure for water distribution, sprinkler irrigation costs are higher than the costs commonly sustained distributing comparable heads by gravity flow.

At 1962 price levels, sprinkler irrigation development costs ranged from \$81 per acre on skid-moved systems delivering 948 gallons per minute to \$146 per acre on hand-moved dry line systems delivering about 150 gallons per minute. The total sprinkler cost per acre (excluding irrigation labor) ranged from about \$16 per acre on a natural gas-fueled system distributing 810 gallons per minute to \$44 per acre on an L.P. gas-fueled system distributing 150 gallons per minute.

Electric-powered systems provided water at the lowest total cost per acre on systems delivering less than 450 gallons per minute. Although the total sprinkler costs per acre were higher, natural gas-fueled systems had lower operating costs per acre than electric-powered systems delivering between 225 and 449 gallons per minute. Total sprinkler costs on L.P. gas-fueled systems were \$2 to \$4 per acre higher than similar costs on comparable natural gas-fueled systems.

Irrigation labor requirements per acre per irrigation are affected by: Sprinkler capacity; area covered per setting; rate of water application; operating time per setting; and type of sprinkler operation. They ranged from a low of 0.72 man-hours per acre per irrigation on wet line expanded systems distributing 810 gallons per minute, to a high of 2.69 man-hours per acre per irrigation on wet line systems distributing 150 gallons per minute.

Shifting from wet line to a dry line type of operation or to wet line expanded system operations reduced net labor requirement per acre per irrigation, but increased total irrigation costs per acre.

Tables.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843

38. Pavelis, G. A. REGIONAL CONSEQUENCES OF ALTERNATIVE POLICIES FOR IRRIGATION DEVELOPMENT. Operations Res. Inc., Amer. Inst. Mangt. Sci., Minneapolis, Minn., Oct. 9, 1964.

A rational method for projecting the acreage of farmland irrigated in the 22 major river basins of the mainland United States was developed. The method incorporates: (1) Historical rates of irrigation development observed between 1939 and 1959 in the Census of Agriculture; (2) approximations of economic limits to irrigation, recognizing such factors as regional variations in soils and water supplies; and (3) alternative hypotheses of the absolute and relative importance of new Federal and non-Federal irrigation development.

The method was used to quantify regional variations in the sensitivity of irrigation to three postulated irrigation policies, ranging from one involving minimal Federal but modest non-Federal development to one postulating no policy constraints. While there was no direct emphasis on optimizing regional rates of future irrigation development, the method illustrated one approach to the problem

of identifying continuing rates of development consistent with dated requirements, including acreages calculated as being optimal for discrete points in time.

RDED, ERS, USDA, Washington, D.C. 20250

Drainage

See Also 10, 29, 93, 137, 141, 151, 176, 188, 212, 310.

39. Pillsbury, A. F., Spencer, J. R., Johnston, W. R., and Weeks, L. O. TILE DRAINAGE PERFORMANCE, COACHELLA VALLEY, CALIFORNIA. J. Irrig. and Drain. Div., ASCE 91 (IR 2): 1-10. June 1965.

The performance of tile drainage systems in a low desert area of high evapotranspiration was evaluated. Factors for use in empirical design equations were developed on the basis of quantity of tile installed and area drained. The tile drainage systems are being used as an efficient method of maintaining a good quality ground water supply by removing the excess saline waters from the crop root zone. This is possible, generally, because the ground water reservoir of the area has become filled through the use of imported water, and, in some cases, artesian pressures have developed. Irrigation efficiencies have been found to be rather poor, but probably beneficial for maintaining good water quality in the ground-water basin.

U. Calif., Los Angeles, Calif. 90024

40. Fouss, J. L., and Fausey, N. R. EXPERIMENTAL PLASTIC DRAINS. Ohio Farm and Home Res. 49(4): 54-55. 1964.

The Soil and Water Conservation Research Division, ARS, USDA and the Ohio Agricultural Experiment Station are conducting intensive research to develop a subsurface drainage method which will provide: (1) Low initial cost; (2) rapid installation; and (3) minimum soil and crop disturbance. Almost all research attempts to develop faster and lower cost methods of drainage during the past 30 years have involved some modifications of the rapid "mole-drain".

Most recent research has centered around the idea of forming a liner within the mole channel from a coiled ribbon of sheet plastic in a continuous operation. The types of plastic mole liners which have been installed and field tested using this method are shown in Figure 1. The earliest mole liner formed from a continuous sheet of plastic was the Busch-type arch (I), which served only as a roof support for the channel. This arch-shaped liner was later modified by adding a thin plastic floor (II). An overlap circular liner (III), and later an overlap-type with a "cap" (IV), were developed by the Caterpillar Tractor Company in cooperation with USDA. These circular liners were formed by merely overlapping the edges of the sheet at the top of the drain.

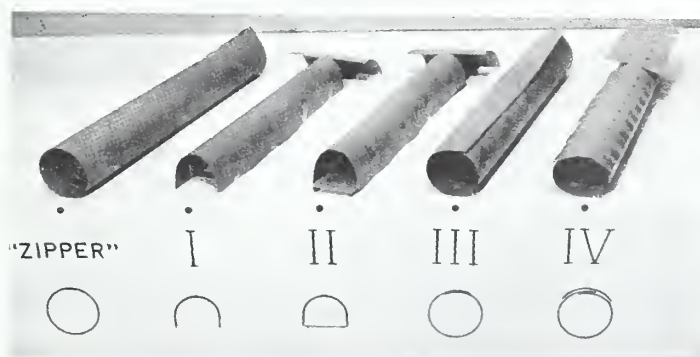


Fig. 1.—Various types of PVC plastic mole drain liners under field test are: Positively closed "zipper" type, (I) Busch-type arch, (II) arch-type with plastic floor, (III) Caterpillar-type overlap, and (IV) Caterpillar-type overlap with "cap".

The investigation in Ohio led to the development of the "zippered" mole drain liner as shown in figure 1. This is a completely closed circular liner, 3 inches in diameter. It is formed from a 0.015-inch-thick polyvinyl chloride (PVC) plastic sheet 10 inches wide which has interlocking tabs prestamped along both edges. The special mole plow and mole-lining implement developed for installing the zipper plastic lining was described. The normal speed of installation is about 125 feet per minute (ground speed) for drain depths as great as 30 to 33 inches. At usual working speeds, about 2,000 feet of drain can be installed per hour.

An automatic grade-control system for the mole drain lining equipment is also being developed.

Field test installations in a heavy soil at the North Central Substation of the Ohio Agricultural Experiment Station and at several other areas in the U.S. have shown the zipper mole liner to be the most promising structurally of the five types shown in figure 1. After 3 years in the field, the zipper-lined drains were still fairly stable, but the original circular channel crosssection was deformed to pear shape because soil immediately over the liner was not recompacted sufficiently during installation. The drain outflow from plastic-lined moles has been essentially the same as that from standard 4-inch drain tile installed in the same soil type.

Use of coiled sheet plastic as a drainage material, rather than preformed drain tube sections, greatly reduces the time, labor, and cost for materials handling from the supplier to the field and during installation. These drains can be installed in many fields without disrupting normal farming operations. Their use eliminates the conventional wide trench, spoil pile, and long-term backfill settlement. These drains should be installed only during the relatively wet season of the year, rather than when soil is fairly dry. The maximum practical depth appears to be about 36 to 42 inches in heavy clay soils.

Probably the most important application of plastic-lined mole drains will be for lateral drains in heavy soils, since their lower cost would permit closer drain spacings than considered economical with present methods.

SWCRD, ARS, USDA, Columbus, Ohio. 43210

41. Laliberte, G. E., and Rapp, E. INFLUENCE OF EVAPORATION ON WATER-TABLE RECESSION. Trans. ASAE 8(2): 275-276, 280. 1965.

In a glacial till soil, the time for water table recession to various depths at various evaporation rates as predicted by the curves developed in this study was not appreciably less with tile drains than with no tile drains. Tile drain spacing closer than 200 ft. was recommended for improvement of drainage at the midpoint between drains.

The water table recession rate following irrigation was significantly influenced by evaporation. With tile drains, the limiting depth of influence was 1.5 to 2.0 ft. below ground surface at the midpoint between drains. With no tile drains, the limiting depth of influence was 2.5 to 3.0 ft. It was concluded that the measurement of evaporation is a necessary part of field experiments on depth and spacing of tile drains.

Canada Agr. Res. Sta., Lethbridge, Alberta, Canada.

42. van Schilfgaarde, J., and Williamson, R. E. STUDIES OF CROP RESPONSE TO DRAINAGE: I. GROWTH CHAMBERS. Trans. ASAE 8(1): 94-97. 1965.

The scarcity of information on the relationship between drainage practices and crop yield resulted in the initiation of a research project on crop response to drainage.

A set of growth chambers was designed and constructed especially for drainage studies. Based on the experience gained from an earlier installation, four chambers were built which provide ambient temperature control $\pm 1\frac{1}{2}^{\circ}$ F. and artificial light at an average intensity of 3,500 ft.-c. Precise humidity control was not considered necessary and not provided. The chambers feature: Simple controls; ready access with a forklift for exchange of soil containers; and a lighting system made up of 2-ft. wide interchangeable modules that can be removed in a matter of minutes. The cost for materials for the chambers was well below the purchase price of commercial units of the same size. Aside from cost, however, no commercial units appear to be available that are adaptable to drainage work.

Experiments in these chambers have demonstrated that, in studying the response of plants to water-table height, the effect of daytime temperature must be carefully considered. It was also shown that not only the response of different species varies considerably but that the response of varieties within a species may be different as well.

It was postulated that plants do not respond to water table per se, but rather to the aeration status of the root zone and/or the availability of moisture. Some data on the change in oxygen concentration in the soil and on the movement of water through the root zone illustrated the type of measurements needed to establish useful criteria for drainage design.

SWCRD, ARS, USDA, Beltsville, Md. 20705

43. Williamson, R. E., and van Schilfgaarde, J. STUDIES OF CROP RESPONSE TO DRAINAGE: II. LYSIMETERS. Trans. ASAE 8(1): 98-100, 102. 1965.

Sheltered and non-sheltered field lysimeters have been found useful for studies of the drainage requirements of crops and preferable to growth chambers in some respects. Two sets of lysimeters with automatically moving rain shelters have been built, differing only in dimensions.

Salinity problems, which can develop quickly with subsurface watering, can be controlled readily with careful management.

Since plant response under wet conditions is primarily a function of the aeration status of the soil, the measurement of soil oxygen, either with bare platinum electrodes or with a membrane-covered platinum electrode, was found to be one of the most effective indices of adequacy of drainage.

Yield data obtained indicated that some deep-rooted crops, such as corn, require a deeper water table than do shallow-rooted crops, such as soybeans. The water-table depths required for maximum growth for most crops used in these experiments were the same for both sheltered and non-sheltered lysimeters.

SWCRD, ARS, USDA, Raleigh, N.C. 27607

Storage and Conveyance

See Also 26, 164, 311, 319, 322, 323.

44. Sloss, R. USE OF PONDS TO MEASURE RATES OF STORM RUNOFF IN LOUISIANA. U.S. Dept. Int., Geol. Sur. Open File Unm. Rpt., 69 pp. 1963.

Ten pond stations in Louisiana were selected for measuring rates of runoff from small drainage basins. The ponds were selected with greater emphasis placed on storage than on outflow as a basis for deriving the inflow hydrograph. Computations for one of the ponds were shown to demonstrate the procedures used. The computation of inflow, storage, and outflow was in accord with the accepted equation based on the law of continuity.

An important criterion in selecting the ponds was that they have storage capacities nearly equal to the maximum volume of storm runoff; so that outflow during a rise would be relatively small. During the investigation, outflow at none of the ponds was greater than 5 percent of the peak rate of inflow to the pond. The optimum ratio of pond area to total drainage area was assumed to be about 1 to 10.

This investigation showed that the use of ponds in measuring runoff from small drainage areas was practicable, and that inflow hydrographs of natural land runoff could be computed within 10 percent except at the low end of the recession. A pond station costs more to establish than a stream-gaging station but less to operate, so when the cost of establishment was spread over a few years the annual cost of a pond station was about the same as that of a stream-gaging station.

No address given.

45. Hiltibran, R. C. THE EFFECT OF DIQUAT ON AQUATIC PLANTS IN CENTRAL ILLINOIS. Weeds 13(1): 71-72. 1965.

Diquat was applied to several emergent, submersed, floating-leaved, and free-floating aquatic plants common in central Illinois ponds. At relatively low rates, it was effective in controlling several submersed aquatic plants but not American pondweed (Potamogeton nodosus) and cabomba, (Cabomba caroliniana). This herbicide also was effective on several common emergent species.

Ill. Natl. Hist., Survey, Urbana, Ill. 61803

46. McGilvrey, F. B., and Steenis, J. H. CONTROL OF ALLIGATORWEED IN SOUTH CAROLINA WITH GRANULAR SILVEX. Weeds 13(1): 66-68. 1965.

Silvex, impregnated (20 percent ae) on clay granules, applied at a rate as low as 20 lb./A. ae gave excellent control of well-rooted alligatorweed (Alternanthera philoxeroides (Mart.) Grieb) growing in less than 18 inches of water. The 2-ethylhexyl ester of silvex was more effective than the potassium salt. Silvex was not effective on floating-mat alligatorweed or in water over 18 inches deep.

Bur. Sport Fisheries and Wildlife, U.S. Fish & Wildlife Serv., Patuxent Res. Cent., Laurel, Md. 20810

BASIC SOIL SCIENCE

Soil Physics

See Also 19, 20, 23, 27, 29, 39, 41, 42, 43, 104, 121, 130, 136, 140, 144, 155, 174, 175, 176, 184, 185, 188, 192, 195, 198, 199, 203, 208, 209, 213, 224, 227, 230, 275, 281.

47. Dyrness, C. T. SOIL SURFACE CONDITION FOLLOWING TRACTOR AND HIGH-LEAD LOGGING IN THE OREGON CASCADES. J. Forestry 63(4): 272-275. 1965.

Soil surface condition and bulk density were investigated after tractor and high-lead logging. Surface area of four clearcut units was classified into four disturbance classes. High-lead and tractor areas had about the same proportion of the slightly disturbed and deeply disturbed classes (approximately 23 percent and 9 percent, respectively). The tractor-logged area had about three times more area within the compacted class than did the high-lead (27 vs. 9 percent) and a corresponding decrease in the amount in the undisturbed class (36 percent of the tractor area vs. 57 percent after high-lead logging).

Surface soil bulk densities of samples from undisturbed and slightly disturbed areas were the same as prelogging values. Values for both the deeply disturbed and compacted classes were significantly higher, indicating a decrease in soil porosity. Compaction caused by tractor logging undoubtedly resulted in some increase in runoff and erosion. However, these undesirable effects were minimized where slopes did not exceed 20 to 30 percent and skidroads were located on the contour.

Pacific Northwest Forest and Range Expt. Sta., FA, USDA, Portland, Oreg. 97208

48. Vomocil, J. A., and Flocker, W. J. DEGRADATION OF STRUCTURE OF YOLO LOAM BY COMPACTION. Soil Sci. Soc. Amer. Proc. 29(1): 7-12. 1965.

Field compaction of Yolo loam soil over 6 years resulted in marked changes in several physical characteristics of the soil. The degradation of structure was more than temporary in that air drying, crushing, and sieving of the soil did not remove all evidence of the deliberate compaction.

Remolded briquets of crushed and sieved soil from the plots receiving supplemental compactive effort had a modulus of rupture of 3,300 millibars, while briquets of soil from plots receiving only the minimum traffic necessary for cultivation over the 6-year period had a modulus of rupture of 1,200 millibars.

The water stability of aggregates by wet sieving was reduced from 9 percent to 2 percent. Unconfined compressive and tensile failure tests on remolded samples

showed that the soil from compacted plots reconsolidated after wetting and drying into stronger casts. Increased mechanical strength of remolded soil from the compacted plots was demonstrated by compression and penetrability measurements. The changes in strength were taken as evidence of reduction of water stability of soil aggregates by compaction. A residual effect of the compaction was definitely detected.

U. Calif., Davis, Calif. 95616

49. Parker, J. J., Jr., and Taylor, H. M. SOIL STRENGTH AND SEEDLING EMERGENCE RELATIONS. I. SOIL TYPE, MOISTURE TENSION, TEMPERATURE, AND PLANTING DEPTH EFFECTS. Agron. J. 57(3): 289-291. 1965.

Laboratory studies were conducted to evaluate effects of soil type, soil moisture tension, temperature, and planting depth on relations between soil strength and seedling emergence. Soil strength was measured with a soil penetrometer and was varied by compressing the entire soil volume. Trials were conducted with 6 soil series at 2/3-bar soil moisture tension and 27° C. In addition, effects of 5 moisture levels and 3 soil temperatures on the relation between soil strength and seedling emergence were evaluated. Effects of planting depth on seedling emergence from high-strength soil were studied for grain sorghum and guar at 1/3-bar soil moisture tension and 27° C. soil temperature.

With 4 of 6 soils tested, small amounts of compression apparently increased seedling emergence, but emergence was progressively decreased by increases in soil strength bars, no emergence occurred. With the other soils tested, no emergence occurred when soil strength was greater than 18 bars.

Rate of emergence was affected by soil strength, soil moisture tension, and soil temperature. However, soil temperature within the range of 21° to 35° C. did not affect total emergence at various soil strengths.

There was only a minor effect of planting depth on the relation between grain sorghum seedling emergence and soil strength. With guar, increasing planting depths drastically reduced emergence through compressed cover soil.

Jr. Author, SWCRD, ARS, USDA, Auburn, Ala. 36830

50. Clapp, C. E., and Emerson, W. W. THE EFFECT OF PERIODATE OXIDATION ON THE STRENGTH OF SOIL CRUMBS: I. QUALITATIVE STUDIES. Soil Sci. Soc. Amer. Proc. 29(2): 127-130. 1965.

Various methods of extraction and oxidation of soil organic matter were used in combination with a sodium saturation technique to assess the binding strength of wet soil crumbs. The procedure consisted of equilibrating a few 3- to 5-mm. crumbs with 0.05 M NaCl, treating the crumbs with chemical reagents to remove the effective stabilizing components, and then observing the degree of slaking and dispersion of the crumbs when the sodium ion concentration was reduced. For crumbs from predominantly montmorillonitic or illitic soils, the dispersion solution was either 0.01 M NaCl buffered with p-nitrophenol at pH 7 or 0.25 M Na₂B₄O₇ at pH 10. For kaolinitic soils, a more severe dispersion technique was required.

The stability of crumbs formed under long-term grass was reduced greatly by oxidation of the organic matter with 0.05 M NaIO₄ followed by extraction with Na₂B₄O₇. Complete dispersion in Na₂B₄O₇ or NaCl/Na p-nitrophenol was obtained when a preliminary extraction with neutral Na₄P₂O₇ was followed by periodate oxidation. The stability of corresponding cultivated crumbs was destroyed completely without pyrophosphate extraction in a shorter period of oxidation. Surface crumbs from wooded sites on the same soils showed extreme resistance to all treatment combinations. It appears that there are two types of polymeric organic material binding the grassland crumbs together, one extractable by pyrophosphate and the other oxidizable by periodate.

Samples from Houston Black clay behaved anomalously until the CaCO₂ was removed by dilute HCl treatment in the cold. The latter process in itself caused no loss in strength of the crumbs.

SWCRD, ARS, USDA, St. Paul, Minn. 55101

51. Clapp, C. E., and Emerson, W. W. THE EFFECT OF PERIODATE OXIDATION ON THE STRENGTH OF SOIL CRUMBS: II. QUANTITATIVE STUDIES. Soil Sci. Soc. Amer. Proc. 29(2): 130-134. 1965.

The rate of consumption of sodium periodate by Fargo clay loam surface grassland crumbs was measured at different periodate concentrations, and the degree of subsequent slaking and dispersion of the crumbs in 0.01 M NaCl/Na p-nitrophenol was observed. Prior leaching of the crumbs with 0.05 M NaCl was essential before crumb stability was reduced appreciably. Maximum loss in strength occurred after the consumption of approximately 0.250 mmoles of periodate per gram of soil.

Release of the effective inorganic and organic binding agents by NaCl, $\text{Na}_4\text{P}_2\text{O}_7$, and NaIO_4 treatments was studied quantitatively. The effect of periodate oxidation alone was demonstrated when no measurable release of organic matter occurred with preliminary leaching by 0.05 M NaCl. The amount of periodate consumed by the grassland crumbs was more than could be accounted for by primary oxidation of the carbohydrate present.

The loss in strength for the grassland crumbs, after systematic removal of the binding agents, was measured quantitatively by means of a plummet balance. The effect of prior leaching with 1 M NaCl followed by 0.05 M NaCl also was investigated. After the combined treatments, dispersion was still incomplete for the Fargo crumbs, indicating some residual bonding. The dispersion of Houston Black clay crumbs was complete, however, when 0.1 M $\text{Na}_4\text{P}_2\text{O}_7$ was substituted for 1 M NaCl. The organic material released by either NaCl or $\text{Na}_4\text{P}_2\text{O}_7$ stabilized the clay-sized fraction of the soil only. The periodate-oxidizable substances stabilized both the silt- and clay-sized fractions.

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52. Webber, L. R. SOIL POLYSACCHARIDES AND AGGREGATION IN CROP SEQUENCES. Soil Sci. Soc. Amer. Proc. 29(1): 39-42. 1965.

Soil polysaccharides and aggregation (mean weight-diameter and aggregate stability) were determined in the corn plots from a rotation project where the preceding crops were corn, oats, alfalfa-brome, or winter wheat. The residues from these crops did not result in significant differences in the content of soil polysaccharides; only in a 2-year crop sequence, corn and oats underseeded with red clover, were the polysaccharides increased by the addition of manure. Aggregate stability was greater in the rotations that included a grass-legume; manure improved aggregation over unmanured plots. In a multiple regression analysis, polysaccharides and organic matter together, accounted for 36 percent of the variation in mean weight-diameter and 27 percent of the variation in aggregate stability.

The season variation in the content of polysaccharides and aggregate stability showed a marked out-of-phase relationship except under oats, which were underseeded with a grass or legume.

Ontario Agr. Expt. Col., Guelph, Ontario, Canada.

53. Cagauan, B., and Uehara, G. SOIL ANISOTROPY AND ITS RELATION TO AGGREGATE STABILITY. Soil Sci. Soc. Amer. Proc. 29(2): 198-200. 1965.

For kaolinitic soils containing more than 5 percent free iron oxide, variations in percentage aggregate stability can be related to soil anisotropy. Soil anisotropy, as used in this paper, refers to the degree of particle orientation.

In thin sections, increasing parallel orientation of clay particles within soil aggregates allows increasing reaction of the soil material to polarized light. For soils having essentially identical mineralogies, the amount of light transmitted through crossed polarizers can be related to particle orientation or soil anisotropy. The amount of transmitted light, which is used to measure soil anisotropy, can be measured with a photometer.

When percentage aggregate stability was plotted as a function of photometer readings, a significant curvilinear relation was found to exist between these two variables.

Jr. Author, U. Hawaii, Col. Trop. Agr., Hawaii Agr. Expt. Sta., Honolulu, Hawaii 96822

54. Bowman, D. H., and King, K. M. DETERMINATION OF EVAPOTRANSPIRATION USING THE NEUTRON SCATTERING METHOD. *Canad. J. Soil Sci.* 45(2): 117-126. June 1965.

The accuracy of evapotranspiration (E.T.) determinations by the neutron scattering method was found by studying each of the possible errors. For the gravelly soils studied the probability error in E.T. was less than 0.15 in. of water for a weekly period and less than 0.62 in. for a 3-month period when one sampling site was used. Increasing the number of sampling sites decreased the error but not in direct proportion. The method was used to provide values for evapotranspiration from irrigated and unirrigated corn, wheat, and clover.

Ontario Agr. Col., Guelph, Ontario, Canada.

55. Young, C. E., Jr., and Henderson, J. E. A METHOD FOR SEALING SOIL MOISTURE ACCESS TUBES. *Soil Sci.* 99(3): 213-214. 1965.

An inexpensive and effective method for sealing the lower end of neutron access tubes used for soil moisture measurements was developed and tested at Charleston, S.C. Tubes sealed by this technique--locally referred to as the "stopper method"--withstand water pressures up to at least 6 pounds per square inch without leaking. Pressures of this magnitude are not uncommon in the lower coastal plain where, over the course of an average year, ground-water levels fluctuate from aboveground surface to many feet below.

Reasons for keeping water out of access tubes are: (1) Neutron moisture probes can be damaged by immersion; (2) even if the probe is waterproofed, soil moisture measurements taken in or at free water in a tube are in error when used with calibration curves based on a dry tube; and (3) with a dry tube, it is possible to take measurements below the water table in order to investigate various hydrologic phenomena.

The stopper method consists of plugging the end of a 2-inch access tube with a rubber stopper coated with a non-hardening gasket sealer and holding the stopper in place against water pressure with two nails running through the tube and stopper. Bentonite clay is placed around the stopper to absorb moisture, swell and further seal the tube, and provide an extra margin of safety against leakage.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N.C. 28802

56. Bowman, D. H., and King, K. M. CONVENIENT CADMIUM-METAL STANDARD FOR CHECKING NEUTRON, SOIL MOISTURE PROBES. *Soil Sci. Soc. Amer. Proc.* 29(3): 325-327. 1965.

A convenient standard was devised for checking the calibration of a neutron-scattering soil moisture depth probe at five fixed points. For a calibration check the probe was placed into one of five waterproof steel tubes immersed in water. Fixed points were obtained by attaching different amounts of cadmium sheet metal to the outside of the tubes to absorb different amounts of the thermal neutrons scattered back by the water. Cadmium-metal standards were applicable as well to surface probes.

Ontario Agr. Col., Guelph, Ontario, Canada.

57. England, C. B. CHANGES IN FIBER-GLASS SOIL MOISTURE-ELECTRICAL RESISTANCE ELEMENTS IN LONG-TERM INSTALLATIONS. *Soil Sci. Soc. Amer. Proc.* 29(2): 229-231. 1965.

The entrance of soil constituents into the interelectrode material of Colman soil moisture units causes changes in calibrated moisture-resistance relations. The degree and abruptness of change is related to depth of placement in the soil. Regular field calibration checks must be performed in order to correct for these changes.

N.C. State, Raleigh, N.C. 27607

58. Ligon, J. T., Benoit, G. R., and Elam, A. B., Jr. PROCEDURE FOR ESTIMATING OCCURRENCE OF SOIL MOISTURE DEFICIENCY AND EXCESS. Trans. ASAE 8(2): 219-222. 1965.

There is a need, particularly in humid areas, for a knowledge of the occurrence of soil moisture deficiency and excess. A procedure was described for determining such occurrences using a soil moisture balance model utilizing as input data generally available climatological data.

Previous work bearing on the subject was reviewed and used as a basis for developing the procedure. Particular attention was given to the relationship between soil moisture level and rate of evapotranspiration. The moisture balance used involves available moisture storage in two soil layers and incorporates evapotranspiration corrections based on the moisture level in each of these layers. The soil moisture balance was checked by comparing computed and measured soil moisture under bluegrass sod and by comparing computed moisture excess with measure streamflow. Generally good agreement was obtained.

U. Ky., Lexington, Ky. 40506

59. Kruger, W. E., and Bassett, D. L. UNSTEADY FLOW OF WATER OVER A POROUS BED HAVING CONSTANT INFILTRATION. Trans. ASAE 8(1): 60-62. 1965.

Unsteady-state, spatially varied surface flow, such as occurs in surface irrigation, can be described by two partial differential equations. These equations were employed to predict the shape of surface profiles and velocity of advance of water as it advanced down a dry, permeable bed having infiltration characteristics which are non-zero and constant over time and distance. The equations were solved numerically using finite difference techniques on a digital computer. Families of unsteady profiles were produced, together with the velocity of advance through the unsteady flow region. Terminal profiles ultimately attained compared favorably with experimentally verified profiles reported by others. Conditions used in this study were simplified compared to those encountered in irrigation. It is significant, however, that other and more realistic terms may be substituted in the equations prior to solution. The development is thus sufficiently general to form a base for analytical description of surface flow under a wide variety of conditions.

SWCRD, ARS, USDA, Lafayette, Ind. 47907

60. Doering, E. J. SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD. Soil Sci. 99(5): 322-326. 1965.

Tests conducted on five soils indicated that the one-step method produced estimates of diffusivity that were as reliable as those produced by other outflow methods. The general agreement between the diffusivity values obtained by the outflow methods and those obtained independently by the constant flux method supported the conclusion that the values were reasonably accurate. The tests also showed that the one-step method was a practical method for determining the diffusivity, because only one equilibration was required for a given range of water content instead of the several equilibrations required for other methods. Fewer equilibrations gave significant reductions in the amount of time needed to analyze each soil sample. The calculations were based upon the instantaneous outflow rate, and the assumption of constant diffusivity over a range of water content was not needed to solve the diffusion equation.

Tests involving separate subsamples of the same soil on membranes having impedances that differed by several orders of magnitude showed that membrane impedance was negligible except near saturation. An effect similar to that which would be caused by boundary impedance was observed, however, during equilibrations that followed the small pressure changes in the same soil samples in the same apparatus.

When the water content versus suction relationship was known, the one-step method also yielded reasonable capillary conductivity values.

SWCRD, ARS, USDA, Mandan, N. Dak. 58554

61. Liakopoulos, A. C. DERIVATION OF DIFFERENTIAL EQUATION GOVERNING SIMULTANEOUS FLOW OF LIQUIDS AND GASES THROUGH POROUS MEDIA. Trans. ASAE 8(2): 210-215. 1965.

The mathematical description of the state of a moving mixture of liquid and gas through a porous medium was effected by means of three functions which give the distribution of the fluid velocity and two thermodynamic quantities in terms of pressure and density. Accordingly, a complete system of five equations is needed and the flowing double-phase liquid has to satisfy them at any point of the considered medium and at any time. The equations are: (1) The Three Navier-Stokes equations relating the dynamical reactions of the fluid to pressure gradients or external forces; (2) the equation of continuity which is the analytical statement of the law of the conservation of matter; and (3) the thermodynamic equation of state which defines thermodynamically the nature and the character of the fluid.

It was shown that a consideration of the five equations, modified so that they take into account the fact that the fluids are at different contents intermixed or segregated and always present simultaneously, leads to separate equations for the liquid phase and the compressible air phase. In case of single-phase flow in porous media where the pressure of the air phase may be neglected, the governing equation is derived and presented in two equivalent forms. The independent variables are the time and the position in space, and the dependent variable is the pressure of the fluid or its volumetric fluid content. The solution of the differential equations, thus derived together with the necessary boundary conditions specified for a particular case, determined completely the state of the moving fluid through a porous medium.

Col. Engin. (UNESCO), Riyadh, Saudi Arabia.

62. Patric, J. H., Douglass, J. E., and Hewlett, J. D. SOIL WATER ABSORPTION BY MOUNTAIN AND PIEDMONT FORESTS. Soil Sci. Soc. Amer. Proc. 29(3): 303-308. 1965.

Absorption of soil water by forest from the top 20 feet of Southern Appalachian and South Carolina Piedmont soil was compared through moisture and matric potential measurements under 50- by 50-foot plastic-covered plots. As predicted by others, early absorption from uniformly moist soil was related primarily to root concentration. However, later absorption from drier soil tended toward uniform extraction even beyond 20 feet in depth. Nonhomogeneous soil horizons (Piedmont) led to irregular early absorption, but still tended toward uniform extraction later on.

The data indicated that where soil matric potential is kept low by frequent rainfall, most transpired water comes from densely rooted surface soil, whereas soil water well beyond rooting depths returns to the surface during long periods without rain. The mobility of soil water in humid areas, and to a lesser extent in drier areas, needs particular attention in water use studies.

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63. Dylla, A. S., and Muckel, D. C. EVAPOTRANSPIRATION STUDIES ON NATIVE MEADOW GRASSES: HUMBOLDT BASIN, WINNEMUCCA, NEVADA. Max C. Fleischman Col. Agr. R. 9, 29 pp. 1964.

Two successive full growing seasons of water-use and hay-yield data of native meadow grasses growing in six lysimeters (ET) tanks at Winnemucca, Nev., were obtained. In 1962, water-use and hay-yield data of grasses growing in ET tanks with water table depths maintained at 4-foot depths showed the following relationship between the tons per acre total hay produced, P, and the inches of water used, W:

$$W = 4.7 P + 11.9$$

In 1963, the water-use and hay-yield data of grasses grown in ET tanks under simulated wet meadow conditions showed the relationship between water used and total hay produced to be:

$$W = 5.7 P + 15.1$$

Comparisons of the total hay produced (two cuttings per season) from the six ET tanks show that average yield decreased from 1.65 tons/A. in 1962 to 1.30 tons/A. in 1963. The first hay cuttings of the season from the ET tank, which is more analogous to available yield records of wild hay from wet meadow areas, showed that average yields decreased from 1.50 tons/A. in 1962 to 1.09 tons/A. in 1963. The average seasonal use of water by grasses in six ET tanks with 4-foot-depth water tables was 19.6 inches, as compared to an average of 22.6 inches for the same six ET tanks when subjected to a simulated wet meadow environment.

Tables and charts.

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64. Dyer, K. UNSATURATED FLOW PHENOMENA IN PANOCHE SANDY CLAY LOAM AS INDICATED BY LEACHING OF CHLORIDE AND NITRATE IONS. Soil Sci. Soc. Amer. Proc. 29(2): 121-126. 1965.

Moisture suctions greater than 15 atmospheres are a common occurrence in the subsoils and substrata underlying unirrigated soils of the Panoche series. One such soil which contained appreciable quantities of Cl^- and NO_3^- was taken from the field at a moisture suction of 16 atmospheres and packed into a column measuring 117 inches in height. This column was partially leached under unsaturated flow conditions with a saturated gypsum solution. Subsequent analyses indicated that about half the original soil moisture was not displaced downward with the dissolved Cl^- and NO_3^- . The Cl^- and NO_3^- concentrations contained in the displaced portion of the soil solution were about double those in the original soil solution existing at 16 atmospheres suction.

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65. Grable, A. R., and Danielson, R. E. EFFECT OF CARBON DIOXIDE, OXYGEN, AND SOIL MOISTURE SUCTION ON GERMINATION OF CORN AND SOYBEANS. Soil Sci. Soc. Amer. Proc. 29(1): 12-18. 1965.

Corn and soybeans were planted in soil-filled glass tubes which were continuously aerated with known mixtures of CO_2 , O_2 , and N_2 . Initial soil moisture suction was varied independently of gas composition. Various aspects of germinative growth were measured during and after various intervals of aeration.

The kind and extent of response obtained from a given CO_2 treatment was influenced in varying degrees by time, soil suction, plant species, and the growth variables measured. The importance of excessive CO_2 as a casual agent of plant injury during germination has probably been overestimated. Corn and soybeans during germination tolerated, and sometimes were stimulated by, CO_2 concentrations higher than those normally found in soils. When CO_2 was sufficiently high to cause severe toxicity, seedlings recovered quickly upon aeration with air. Comparatively small changes in soil moisture suction often completely overshadowed the effect of different CO_2 levels on root growth. In general, growth increased as soil moisture suction decreased; but excessive soil moisture, apart from the aeration treatments used, severely limited or completely stopped germinative growth. With corn, the effect occurred at soil saturation and was probably due to reduced O_2 diffusion rates. With soybeans, the effect occurred at a lesser moisture content and was due primarily to invasion by pathogenic organisms.

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66. Grable, A. R., and Danielson, R. E. INFLUENCE OF CO_2 ON GROWTH OF CORN AND SOYBEAN SEEDLINGS. Soil Sci. Soc. Amer. Proc. 29(3): 233-238. 1965.

Pregerminated corn and soybeans were grown at near constant moisture suction in soil contained in plastic cells. The cells were constructed to permit differential aeration of either tops and roots separately, or the two together. Silicone rubber or wax on the soil surface separated top and root atmospheres. Gas mixtures of known concentrations of CO_2 , O_2 , and N_2 , were used for continuous forced aeration. Measurements and observations of various aspects of plant growth showed that both

plant species were of tolerant of high CO₂, concentrations. Plants grew satisfactorily for several days when tops, roots, or both received 20 percent or more of CO₂; lesser CO₂ concentrations often stimulated top and root growth as compared with air treatment.

SWCRD, ARS, USDA, Grand Junction, Colo. 81502

67. Eckardt, F. E. ed. METHODOLOGY OF PLANT ECO-PHYSIOLOGY: PROCEEDINGS OF THE MONTPELLIER SYMPOSIUM. UNESCO Pub. Arid Zone Res. Ser. 25, 531 pp. \$20. 1965.

More than 120 specialists gathered at Montpellier, France, in April 1962, to discuss the relationships existing between plants and their physical and biotic environment. The texts of 58 of the papers presented at the meeting were given.

In general, these cover three main fields: Environmental Factors; Physiology of Plants Considered Individually; and Physiology of the Plant Cover. All papers were in English or were summarized in English. Discussions were in both English and French.

Special emphasis was laid throughout upon the description of methods to make possible the study of the physiological behavior of the plant cover considered as a whole. In addition to details on measuring techniques, each paper concluded with a bibliography.

UNESCO Pub. Cent., Natl. Agency for Internatl. Pub., Inc., 317 East 34th Street, New York, N.Y. 10016

68. McMurdie, J. L. STRAIN ENERGY AND YIELD OR FRACTURE IN YOLO LOAM. Soil Sci. Soc. Amer. Proc. 29(3): 238-242. 1965.

Data on strain energy components were reported for drained, consolidated-undrained, and compacted tests on Yolo loam obtained by standard procedures using triaxial test equipment. The ratio of recoverable distortional to recoverable volume energy was proposed as an energy criterion for failure and as an approximation to this ratio studied. The approximation assumes that the recoverable distortional energy is a constant fraction of the distortional strain energy added to the sample by the deformation in any one test. The ratio was found to be constant, but of differing values, for the drained and consolidated-undrained tests and to vary for compacted samples.

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Soil Chemistry and Mineralogy

See Also 35, 50, 107, 108, 113-117, 120, 121-131, 136, 138-140, 172, 188, 189, 191, 193, 195, 196, 198, 200, 231, 247.

69. Gopalachari, N. C., Ramakrishnayka, B. V., and Murty, K. S. CATION-ANION BALANCE IN FLUE-CURED TOBACCO. Soil Sci. 99(3): 157-160. 1965.

A balance was noticed between the milli-equivalent sums of cations ($\text{Ca}^{++} + \text{Mg}^{++} + \text{K}^{+}$) and anions ($\text{H}_2\text{PO}_4^- + \text{SO}_4 = + \text{Cl}^- + \text{NO}_3^- + \text{organic acids}$) determined in Indian flue-cured tobacco leaf, irrespective of the fertilizer, irrigation, and topping treatments given. The ratio total-cations/total-anions remained constant, close to unity. Irrigation increased the uptake of total cations as well as total anions, but their ratio remained constant and undisturbed. Organic acid anions accounted for a major part (63 percent) of the total cations, thus manifesting their important role in the cation-anion balance in flue-cured tobacco.

Central Tobacco Res. Inst., Rajahmunday, India.

70. Jackson, W. A., Craig, D., and Lugo, H. M. EFFECTS OF VARIOUS CATIONS ON CESIUM UPTAKE FROM SOILS AND CLAY SUSPENSIONS. Soil Sci. 99(5): 345-353. 1965.

Effects of added salts on plant uptake of Cs-137 from soils and clay suspensions were examined. For the soils used, NH₄ was more effective than K, but less effective than Rb, in maintaining Cs-137 in solution. Potassium

reduced Cs-137 uptake and NH_4 increased it. The effect of Rb was variable; Cs-137 uptake increased sharply at lower Rb concentrations but at higher concentrations it was restricted. The data suggest net Cs-137 uptake resulted from a combination of the effects of the added cations on maintaining Cs-137 in solution and their effects on inhibition of uptake and transport processes by the plants, NH_4 being less effective than K or Rb in the latter.

Experiments with Utah bentonite suspensions for shorter time periods supported the observations with the soil systems.

N.C. State, Raleigh, N.C. 27607

71. Dyer, K. L. INTERPRETATION OF CHLORIDE AND NITRATE ION DISTRIBUTION PATTERNS IN ADJACENT IRRIGATED AND NONIRRIGATED PANOCHE SOILS. Soil Sci. Soc. Amer. Proc. 29(2): 170-176. 1965.

Salt profiles of sprinkler-irrigated soils, with known crop histories, were compared with those of adjacent soils which had not been irrigated. The methods described offer, for some areas, new techniques for estimating salt movements toward the water table and for evaluating past performance of irrigation projects.

Theoretical concentration curves obtained, using van der Molen's application of the Glueckauf theory of chromatography, were successfully fitted to Cl^- and NO_3^- concentration curves found in soils being leached under field conditions.

The accumulation of Cl^- in the soil profile was used in conjunction with Cl^- concentration in the soil solution to obtain an independent estimate of moisture dissipated by evapotranspiration. Evapotranspiration losses of sprinkler applied irrigation water were estimated by this method to range from 78 to 85 percent in the soils under investigation. Estimates of total applied irrigation water calculated from the accumulation of Cl^- in the soil profile were in general agreement with estimates made from crop history.

SWCRD, ARS, USDA, Fresno, Calif. 93726

72. Douglas, L. A. CLAY MINERALOGY OF A SASSAFRAS SOIL IN NEW JERSEY. Soil Sci. Soc. Amer. Proc. 29(2): 163-167. 1965.

The clay mineralogy of a SassafRAS soil was studied. Illite was the dominant clay mineral in the C horizon, and aluminum-interlayered vermiculite was the dominant clay mineral in the A_1 horizon. The weathering series: Illite $\rightarrow$ expanding-vermiculite $\rightarrow$ vermiculite $\rightarrow$ aluminum-interlayered vermiculite accounted for the major clay mineral alterations in this soil. The distribution of kaolinite suggested that kaolinite is being formed in the soil. Lepidocrocite was found in horizons containing large amounts of easily reducible iron.

N.J. Agr. Expt. Sta., Rutgers-The State U. N.J., New Brunswick, N.J. 08903

73. Reeve, R. C., and Doering, E. J. SAMPLING THE SOIL SOLUTION FOR SALINITY APPRAISAL. Soil Sci. 99(5): 339-344. 1965.

Apparatus for sampling the soil solution, was described and procedures for obtaining samples were given. Typical data showed a time sequence of composition changes in the soil solution as determined by the suction method for a leaching study involving reclamation of a sodic soil. The suction extraction method of evaluating soil salinity was compared to the conventional saturation extract method, with the soil samples being taken while the soil was essentially saturated. The agreement of the two methods was well within the limits of the errors of measurement.

Data were presented which showed the variation of the composition of the soil solution in the root zone of birdsfoot trefoil growing in a laboratory column. Under approximately steady-state conditions, the electrical conductivity of the soil solution increased with depth in the root zone.

Reliable and consistent values for soil solution composition were obtained by the suction method in the soil suction range of 0 to 500 millibars. Since most water movement in soil occurs in this suction range, this method may be useful in many operations such as irrigation, leaching, reclamation, ground water recharge,

waste water disposal, and others where the composition of the soil solution is of interest.

SWCRD, ARS, USDA, Columbus, Ohio. 43210

74. International Atomic Energy Agency. PLANT NUTRIENT SUPPLY AND MOVEMENT: REPORT OF A PANEL ON THE USE OF ISOTOPES AND RADIATION IN PLANT NUTRIENT SUPPLY AND MOVEMENT IN SOIL SYSTEMS. Internatl. Atomic Energy Agency: Tech. Rpt. Ser. 48, 160 pp. \$3.50. 1965.

The application of research to specific, practical problems is often preceded by efforts aimed at more fundamental ones. To help solve both types of problem in agricultural research, radiation and radioisotopes are widely used.

Among the activities sponsored by the Joint FAO/IAEA Division of Atomic Energy in Agriculture is "A Co-ordinated Programme on Plant Nutrient Supply and Movement in Soil Systems."

A meeting of the contractors and invited participants was held in Vienna from November 9 to 13, 1964, to discuss the results reached under specific contracts and some related scientific topics.

A summary and recommendations were given along with the following papers:

75. Seligman, H. OPENING ADDRESS.
76. Fried, M. ION UPTAKE IN THE SOIL PLANT NUTRIENT SYSTEM.
77. Thomas, H. C. TOWARD A CONNECTION BETWEEN IONIC EQUILIBRIUM AND IONIC MIGRATION IN CLAY GELS.
78. Laudelout, H. A UNIFIED TREATMENT OF TWO ION-EXCHANGE FORMULATIONS COMMONLY USED IN SOIL SCIENCE.
79. Szabolcs, I., and Darab, K. NEW TRENDS IN ION-EXCHANGE STUDIES ON SALINE AND ALKALI SOILS.
80. Chaussidon, J. MOBILITIES OF CATIONS IN SOILS AND CLAYS AT VERY LOW MOISTURE CONTENT.
81. Graham-Bryce, I. J. DIFFUSION OF CATIONS IN SOILS.
82. Dakshinamurti, C. IONIC MIGRATION IN SOILS AND CLAYS.
83. Lewis, D. G., and Quirk, J. P. DIFFUSION OF PHOSPHATE TO PLANT ROOTS.
84. Larsen, S., and Gunary, D. DIFFUSION IN SOIL CRUMBS.
85. Reiniger, P., and Lahav, N. SELF-DIFFUSION OF CALCIUM-45 INTO CERTAIN CARBONATES AND CALCAREOUS SOILS.
86. Laudelout, H., and Cremers, A. TORTUOSITY EFFECTS IN CLAY GELS.
87. Bolt, G. H., and de Haan, F. A. M. INTERACTIONS BETWEEN ANIONS AND SOIL CONSTITUENTS.
88. Zmijewska, W., and Minczewski, J. DETERMINATION OF SOME MICROCOMPONENTS OF SOIL SOLUTIONS BY NEUTRON ACTIVATION ANALYSIS.
89. Nishigaki, S. ACTIVATION ANALYSIS IN SOIL/PLANT RELATION STUDIES IN SOUTH-EAST ASIA.
90. Cho, C. M., and Axmann, H. DETERMINATION OF MICRO-QUANTITIES OF SEVERAL ELEMENTS IN SOIL SOLUTION BY ISOTOPE DILUTION AND ACTIVATION ANALYSES.
91. Olsen, S. R. PHOSPHORUS DIFFUSION TO PLANT ROOTS.

92. Lamm, C. G. TENTATIVE INTEGRATION OF NEW TRENDS AND METHODS IN THE STUDY OF SOIL/PLANT RELATIONSHIPS.

For Sale, Natl. Agency for Internatl. Pub., Inc., 317 East 34th Street, New York, N.Y. 10016

93. Johnston, W. R., Ittihadieh, F., Daum, R. M., and Pillsbury, A. F. NITROGEN AND PHOSPHORUS IN TILE DRAINAGE EFFLUENT. Soil Sci. Soc. Amer. Proc. 29(3): 287-289. 1965.

Tile drainage effluent from systems on irrigated land in the San Joaquin Valley of California was analyzed for nitrogen and phosphorus and the quantity of each element found was correlated with the quantity of N and P applied for four different cropping patterns. Large percentages of applied N were found to be lost in tile drainage effluent. Phosphorus losses were not significant.

U. Calif., Los Angeles, Calif. 90024

94. Sawhney, B. L. SORPTION OF CESIUM FROM DILUTE SOLUTIONS. Soil Sci. Soc. Amer. Proc. 29(1): 25-28. 1965.

Sorption of Cs by a synthetic cation-exchange resin and by several clay minerals, over a range of low Cs concentrations, was studied in the presence of different counter-ions. An ion-exchange equation was used to predict the sorption of Cs from dilute solutions.

Exchange isotherms showed that the sorption of Cs by the resin followed these predictions: Exchange isotherms were straight lines with unit slope. Sorption of Cs by clay minerals, however, did not follow these predictions except when K^+ was the competing cation. When Ca^{2+} and Al^{3+} were the competing cations, the exchange isotherms for montmorillonite were straight lines with less than unit slope, showing that a larger proportion of Cs was sorbed with decreased Cs concentrations. The exchange isotherms of illite and vermiculite had at least two distinct slopes suggesting that more than one type of exchange site was involved in the sorption of Cs by these minerals. These conclusions were also supported by estimates of the equilibrium constants calculated from Vanselow's equation.

Conn. Agr. Expt. Sta., New Haven, Conn. 06268

95. Mangaroo, A. S., Himes, F. L., and McLean, E. O. THE ADSORPTION OF ZINC BY SOME SOILS AFTER VARIOUS PRE-EXTRACTION TREATMENTS. Soil Sci. Soc. Amer. Proc. 29(3): 242-245. 1965.

The adsorption of zinc by six soils was determined. Soils that formed under slightly acid or neutral conditions usually adsorbed larger quantities of Zn than soils formed under very acid conditions. The stability constants for the soil-zinc systems after displacement of Zn by KCl and $Cu(OAc)_2$ were also higher for the near neutral soils. Soil from the A_p -horizon was compared to soil from the A_1 -horizon of the Hoytville soil series. The organic matter content did not explain the differences in the amounts of Zn adsorbed.

The adsorption of Zn by the soils after extraction with hot water or C_6H_6 -MeOH were usually slightly less than the nonextracted soil. However, the quantities of Zn adsorbed by the soils after extraction with NaOH were greater than the nonextracted soils. A large percentage of this Zn was not displaced with KCl but was displaced with $Cu(OAc)_2$.

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96. Broadbent, F. E., and Nakashima, T. PLANT RECOVERY OF IMMOBILIZED NITROGEN IN GREENHOUSE EXPERIMENTS. Soil Sci. Soc. Amer. Proc. 29(1): 55-59. 1965.

A series of greenhouse pot experiments was conducted to measure plant uptake of fertilizer N in the presence and absence of straw. Soils were incubated with straw for periods up to 12 weeks to overcome the depressing effect of straw and then cropped. Two or more crops were evaluated for each treatment. In spite of preincubation, plant recovery of N was invariably lower where straw had been added,

even when the level of fertilizer N added was equivalent to 2.5 percent of the weight of straw.

The presence of growing plants on the soil during the period immediately following application of fertilizer N resulted in more efficient utilization of fertilizer than where planting was delayed several weeks after fertilizer application. This was true whether straw was added or not.

A tracer experiment lasting nearly 2 years indicated progressive stabilization of fertilizer N after incorporation into the soil organic fraction.

U. Calif. Davis, Calif. 95616

97. Nikishkina, P. I. EFFECT OF THE PROLONGED USE OF ORGANIC AND MINERAL FERTILIZERS ON THE AVAILABILITY OF MICRO-ELEMENTS IN THE SOIL. Soviet Soil Sci. 9: 815-830. Sept. 1963.

The influence of the long-term addition of organic and mineral fertilizers on the content and availability of micro-elements in typical soils was determined. The author concluded that:

1. The systematic application of mineral and organic fertilizers to sod-podzolic soils changed not only the content of micro-elements in them, but also that of available forms of micro-elements.
2. The application of manure increased the content of total and water-soluble boron. This increase varied from 0.05 to 0.132 mg./kg. of soil for water-soluble boron in various soils. The systematic application of mineral fertilizers (NPK) resulted chiefly in a decrease in the content of total and water-soluble boron in the soil.
3. The amount of molybdenum entering the oxalate extract increased in all the manured soils. The increase in the content of available molybdenum in the soil after the systematic application of manure ranged from 0.004 to 0.067 mg./kg of soil in various soils. No reliable changes were found in the content of available molybdenum in the soils as a result of application of mineral fertilizers.
4. The application of manure produced an increase of the amount of cobalt entering a 1.0 N nitric acid extract in the soil. This increase varied from 0.1 to 0.30 mg./kg. of soil in various soils.
5. The systematic addition of manure in crop rotation enriched the soil with available forms of boron, molybdenum, and cobalt. At the same time, acidity decreased and the content of humus and of available forms of phosphorus and potassium increased.

Scripta Technica Inc., 1000 Vermont Ave., N.W., Washington, D. C. 20005

98. Cummings, G. A., and Teel, M. R. EFFECT OF NITROGEN, POTASSIUM, AND PLANT AGE ON CERTAIN NITROGENOUS CONSTITUENTS AND MALATE CONTENT OF ORCHARDGRASS (DACTYLIS GLOMERATA L.). Agron. J. 57(2): 127-129. 1965.

Malate, true-protein nitrogen, free-amino nitrogen, and nonprotein nitrogen other than free-amino nitrogen were positively correlated with nitrogen supply with both 4- and 6-week-old orchardgrass leaves. The degree of association varied with plant age and potassium content. Nonprotein nitrogen compounds and malate were negatively correlated with potassium. True protein was positively correlated with the potassium content.

N.C. State, U. N.C., Raleigh, N.C. 27607

99. Powell, A. J., Jr., and Hitcheson, T. B., Jr., EFFECT OF LIME AND POTASSIUM ADDITIONS ON SOIL POTASSIUM REACTIONS AND PLANT RESPONSE. Soil Sci. Soc. Amer. Proc. 29(1): 76-78. 1965.

Lime and/or wetting-drying cycles following its application to soils of micaceous mineralogy resulted in lower exchangeable K levels, as measured by $\text{N NH}_4\text{OAc}$ extraction, which were closely correlated with K levels before liming. K level changes were not related to initial pH levels over a range from pH 4.7 to 6.2. Liming effects on exchangeable K levels were not reflected by crop response or uptake of K.

Release of non-exchangeable K was enhanced and fixation of applied K was prevented by lime applications. It was suggested that Ca^{2+} ions may prop open edges of clay mineral packets, thus preventing entrapment of K^+ ions and releasing previously "trapped" or lattice K.

Jr. Author, Va. Polytech. Inst., Blacksburg, Va. 26506

100. Hamilton, H. A., and Lathwell, D. J. INFLUENCE OF SALTS IN ASSOCIATION WITH MONOCALCIUM AND DIAMMONIUM PHOSPHATES ON THE CHEMICAL CHARACTERISTICS AND MOVEMENT OF SOIL SOLUTION. *Canad. J. Soil Sci.* 45(2): 139-152. June 1965.

Various salts thoroughly mixed with monocalcium phosphate monohydrate (MCP) and diammonium phosphate (DP) were made to react with moist Lima silt loam soil arranged in 5-mm. layers and separated by filter papers. After a reaction period of 3 weeks, soil moisture, pH, hot nitric acid-soluble phosphorus, and sodium bicarbonate-soluble phosphorus were determined in the different layers. As compared with MCP, the more soluble salts in association with MCP enhanced soil solution movement away from the fertilizer layer, and there was considerably greater movement of phosphorus into soil layers than for MCP, with the result that phosphorus was distributed into a greater volume of soil. When calcium sulfate was associated with DP, movement of soil solution and the diffusion of phosphorus into soil layers was markedly restricted because of massive precipitation reactions. At the soil layer closest to the MCP-fertilizer layer, a pH of 2.8 units developed. These very acid conditions were in every case ameliorated when MCP was associated with different soils. No changes in the natural soil pH were occasioned by the use of DP.

By sampling soil solutions with filter papers at increasing distances from a fertilizer layer containing MCP, considerable amounts of Al, Fe, Mn, and Ca were detected. When various salts were associated with MCP, the amounts of soluble constituents moved to greater distances than with pure MCP, thereby effecting a greater diffusion of potentially toxic elements into a greater volume of soil. Chloride salts were particularly effective in causing the diffusion of manganese away from the fertilizer layer. No measurable amounts of Al, Fe, or Mn were found in soil solutions when DP reacted in soil.

Res. Sta., Canada Dept. Agr., St. Jean, Quebec, Canada.

101. Mortvedt, J. J., and Osborn, G. BORON CONCENTRATION ADJACENT TO FERTILIZER GRANULES IN SOIL, AND ITS EFFECT ON ROOT GROWTH. *Soil Sci. Soc. Amer. Proc.* 29(2): 187-191. 1965.

Rates of dissolution of B from granules of rasorite and three boronated fertilizers in limed Hartsells fine sandy loam decreased in the order: Nitric phosphate (2.2 percent B) > rasorite (20.2 percent B) >> calcium silicate slag (7.5 percent B) > calcium metaphosphate (2.1 percent B). Movement of B from the granules increased with B-concentration gradient and soil moisture content.

Concentration of hot water-soluble B in soil near the granules at a given time depended on: (1) B content of the granule; and (2) the relative rates of B dissolution from the granule and movement of B from the granule site. Concentrations of B near rasorite granules--as high as 80 parts per million (p.p.m.) in a large volume (4 kg. of soil in gallon cans) and 385 p.p.m. in thin soil layers (80 g. of soil in Petri dishes)--were inversely proportional to the amount of soil affected.

Root growth of oats and alfalfa was slightly depressed at soil B concentrations of 2 to 5 p.p.m., and markedly so at concentrations above 10 p.p.m. B. Thus, high concentrations in soil near some B sources may inhibit root growth. Root injury may be prevented by decreasing the B content per fertilizer granule and by applying less soluble sources or lower amounts of B.

TVA, Wilson Dam, Ala. 35660

102. Peck, N. H., MacDonald, G. E., Vittum, M. T., and Lathwell, D. J. ACCUMULATION AND DECLINE OF AVAILABLE PHOSPHORUS AND POTASSIUM IN A HEAVILY FERTILIZED HONEOYE SILT LOAM SOIL. Soil Sci. Soc. Amer. Proc. 29(1): 73-75. 1965.

Seven years of different rates of fertilizer application on vegetable crops were followed by 2 years when only N was applied. Fertilizer P and K treatments were then superimposed for the next 6 years.

During years of application of fertilizer P and K, residual soil P and K accumulated in available forms as measured by soil tests. The higher the rate of application of fertilizer P and K, the higher was the accumulation of available soil P and K. After applications of fertilizer P and K were discontinued, there was a rapid decline in residual available soil P and K. After 8 years without application of fertilizer P and K, there was still a highly significant residual soil P effect, and a significant residual soil K effect in one of the two fields.

N.Y. State Agr. Expt. Sta., Geneva, N.Y. 14456

103. Kubota, J. DISTRIBUTION OF TOTAL AND EXTRACTABLE FORMS OF COBALT IN MORPHOLOGICALLY DIFFERENT SOILS OF EASTERN UNITED STATES. Soil Sci. 99(3): 166-174. 1965.

In Eastern United States, coarse-textured podzols have been associated with Co deficiency of ruminant animals. These soils have relatively small amounts of total soil Co, and only a small percentage of the Co present is extractable with dithionite or acetic acid. The small amount of extractable Co indicates that much of the reactive forms of Co has been removed from these soils.

On the other hand, red-yellow podzolic soils, gray-brown podzolic soils, and their intergrades have more Co than do the sandy podzols. The Co present, moreover, is fairly easy to extract. Nearly half of the total Co can be extracted with dithionite from surface horizons of these soils. Dithionite-extractable Co, furthermore, increases with acetic-acid-extractable Co, a form of Co commonly related to plant content.

More of the Co was dithionite-extractable from the A than from the B horizon of the red-yellow podzolic soils studied. The fact that there was more dithionite-extractable Co in the A than in the B horizon suggests that Co may be preferentially absorbed by deeply rooted shrubs and cycled, or that the surface Co is replenished through surface deposition of fine dust that has its origin in the Western United States.

SCS, USDA, Ithaca, N.Y. 14850

104. Hosner, J. F., Leaf, A. L., Dickson, R., and Hart, J. B., Jr. EFFECTS OF VARYING SOIL MOISTURE UPON THE NUTRIENT UPTAKE OF FOUR BOTTOMLAND TREE SPECIES. Soil Sci. Soc. Amer. Proc. 29 (3): 313-316. 1965.

Tupelo gum (*Nyssa aquatica* L.), pin oak (*Quercus palustris* M.), green ash, (*Fraxinus pennsylvanica* M.), and sycamore seedlings (*Platanus occidentalis* L.) were subjected to four soil moisture regimes for 84 days in greenhouse soil cultures. The moisture regimes included: (1) Saturated soil; (2) moisture equivalent-return to moisture equivalent daily; (3) 50 percent available water-return to moisture equivalent when 50 percent of the available water had been removed; and (4) wilting point-return to moisture equivalent when the wilting point had been reached.

Comparisons among species and treatments were made on dry weight per seedling top, and contents per seedling top and foliar concentrations of ash, N, P, K, Ca, and Mg. Generally, the seedling top weight and nutrient uptake for pin oak, green ash, and sycamore showed the following trend: Saturated soil < moisture equivalent > 50 percent available water > wilting point. Similar data for tupelo gum showed only decreasing values with increasing moisture stress from saturated soil to wilting point.

Generally, tissue nutrient concentrations tended to be low for seedlings subjected to saturated soils and high for those subjected to wilting point regime, thus moisture treatments apparently affected growth more than nutrient absorption.

Va. Polytech. Inst., Blacksburg, Va. 23501

105. Turner, R. C., and Clark, J. S. LIME POTENTIAL AND DEGREE OF BASE SATURATION OF SOILS. Soil Sci. 99(3): 194-199. 1965.

The lime potentials and degrees of Ca + Mg saturation of the exchange phase of 31 soils were determined. The relationship between the two variables was compared with that predicted by an equation suggested by Turner and others (1958). When the exchange material of a soil was predominately montmorillonite, the lime potential of that soil was always equal to or less than the value predicted by the equation from its degree of Ca + Mg saturation. With the other soils, the lime potentials were always equal to or greater than calculated values.

The values of the ion product $(Al)(OH)^3$ in the dilute $CaCl_2$ solutions at equilibrium with the soils were generally lower for the montmorillonitic soils than the value of $10^{-33.8}$ used to calculate the theoretical curve. With the non-montmorillonitic soils, these ion products were greater than the value used in the equation. When adjustments were made to eliminate the effect of these variable ion products, the lime potentials at a given degree of Ca + Mg saturation were not greatly different for the two groups of soils, and the values agreed reasonably well with the value predicted by the equation.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Canada.

106. Meek, B. D., and MacKenzie, A. J. THE EFFECT OF NITRITE AND ORGANIC MATTER ON AEROBIC GASEOUS LOSSES OF NITROGEN FROM A CALCAREOUS SOIL. Soil Sci. Soc. Amer. Proc. 29(2): 176-178. 1965.

The loss of gaseous nitrogen compounds when nitrite accumulates in a calcareous silty clay loam during nitrification was investigated under aerobic conditions.

Ammonium sulfate, ammonium sulfate plus straw, and sodium nitrate were added to Holtville silty clay loam soil, in separate experiments, and incubated at 28° C. and 31 percent moisture for 28 days. Samples were maintained under aerobic conditions in a N-free atmosphere of 21 percent oxygen and 79 percent helium. Gas samples were taken every 7 days from the incubation flasks and analyzed, using a gas chromatograph, for gaseous N products evolved. The accumulation of nitrite was measured on separate soil samples incubated in the same manner as the flasks used to secure gas samples.

The gaseous N forms produced were N_2O and N_2 . It was found that losses were low even when large amounts (250 p.p.m.) of nitrite-N accumulated. The gaseous N loss was 1.3 percent for $(NH_4)_2SO_4$ and $NaNO_2$ and 3.6 percent for the $(NH_4)_2SO_4$ + barley straw treatment.

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Soil Biology

See Also 65, 67, 124, 172, 200, 244.

107. Randhawa, N. S., and Broadbent, F. E. SOIL ORGANIC MATTER-METAL COMPLEXES: V. REACTIONS OF ZINC WITH MODEL COMPOUNDS AND HUMIC ACID. Soil Sci. 99(5): 295-300. 1965.

Zinc was found to be adsorbed as the divalent species by solid phase model compounds in contact with 0.1 M zinc acetate solution. Carboxylic acids and acidic phenols were represented among the compounds tested. With respect to these compounds, zinc behaved as a weaker acid than copper but stronger than barium.

Zinc retention by these pure compounds was determined principally by the pH of the solution. The limiting pH for a given site was dependent upon the acidity and type of exchange site and on the nature of the cation. Below the critical pH, adsorption of zinc failed to occur, irrespective of the amount of exchanger present or concentration of zinc ion.

Humic acid was found to have three or more types of sites capable of retaining zinc. Zinc adsorbed on some of the sites could be desorbed only by 0.1 N or stronger HNO_3 , indicating a very stable complex. Although the number of such sites was small, representing less than 1 percent of the total retention capacity, these

sites in soil may be of great importance from the standpoint of plant nutrition, since small quantities of zinc would be adsorbed preferentially in the most stable form.

Normal potassium chloride and 0.01 N acetic acid were found to be approximately equal in their ability to displace zinc adsorbed on humic acid. Zinc was more strongly bound on humic acid than calcium, but less strongly than copper or ferrous iron.

U. Calif., Davis, Calif. 95616

108. Kang, K. S., and Felbeck, G. T., Jr. A COMPARISON OF THE ALKALINE EXTRACT OF TISSUES OF ASPERGILLUS NIGER WITH HUMIC ACIDS FROM THREE SOILS. Soil Sci. 99(3): 175-181. 1965.

An alkali-soluble, acid-insoluble material was isolated from the spores of Aspergillus niger. The chemical and physical properties of this material were compared with those of humic acids isolated from three soils of widely different characteristics. On the basis of the amino acid and simple sugar contents of the hydrolysates, elemental analysis, methoxyl content, behavior on a continuous-flow paper curtain electro-phoresis apparatus, solubility in cold 72 percent sulfuric acid, and cation-exchange capacity, the spore extract appears to be similar to the humic acids. The significance of these results were discussed in relation to the possible origin of the humic acids in soils.

Del. Agr. Expt. Sta., Newark, Del. 19711

109. Corden, M. E., and Young, R. A. CHANGES IN THE SOIL MICROFLORA FOLLOWING FUNGICIDE TREATMENTS. Soil Sci. 99(4): 272-277. 1965.

In soil treated with CP-30249, Metasol, Mylone, nabam, and Vapam, the fungal populations decreased rapidly and then increased, due to reproduction of certain fungi. Six months after treatment with Mylone, however, the fungal population was significantly lower than in untreated soil; contrarily, in soil treated with Metasol it was 25 times greater. Increases were due primarily to development of Trichoderma spp., in soil treated with nabam, and CP-30249, and to Penicillium spp. in soil treated with Mylone, Metasol, and Vapam. The bacterial population of the soil increased following treatment with Mylone and Metasol, but eventually decreased similarly to the bacterial population in untreated soil. The actinomycete population of the soil was reduced by all fungicides, but Metasol and CP-30249 were particularly effective against these organisms. The actinomycete population began to increase 1 month after treatment with Metasol. The selective action of these fungicides offers an excellent opportunity to establish soil organisms antagonistic to plant pathogens.

Oreg. State U., Corvallis, Oreg. 97331

110. Alexander, M. PERSISTENCE AND BIOLOGICAL REACTIONS OF PESTICIDES IN SOILS. Soil Sci. Soc. Amer. Proc. 29(1): 1-7. 1965.

Although microorganisms are often considered to be omnivorous and biochemically omnipotent, they seem unable to destroy at significant rates many synthetic chemicals that enter soil. This unexplained microbial fallibility has recently assumed prominence because of the long persistence of a variety of pesticides. With at least certain compounds, the chemical, physiological, or environmental basis of the biological failings can be established, as illustrated with substituted phenols and phenoxy herbicides.

Microorganisms may detoxify pesticide-treated soil by metabolizing or degrading the added substance. The microflora may also be responsible for the generation of a toxic condition in soil by activation of the applied pest-control agent. The use of laboratory precedents as guides in investigations of natural transformations was considered, and instances of pesticide metabolism in soil were cited.

N.Y. State Col. Agr., Cornell U., Ithaca, N.Y. 14850

111. Johnson, H. W., Means, U. M., and Weber, C. R. COMPETITION FOR NODULE SITES BETWEEN STRAINS OF *RHIZOBIUM JAPONICUM* APPLIED AS INOCULUM AND STRAINS IN THE SOIL. *Agron. J.* 57(2): 179-185. 1965.

The success of strains of *Rhizobium japonicum* applied as inoculum in different amounts and by different methods in producing nodules on soybeans (*Glycine max* (L.) (Merr.)) was evaluated over a 3-year period in soils containing effective strains of the bacteria. Strains differed greatly in the proportion of nodules produced even when applied as inoculum at 700 times the standard rate.

The average recovery of strains applied at the standard rate of inoculation was 5 percent. However, the recovery of the test strains applied with a sticking agent at 25 times the standard rate was at least five times the recovery from the standard procedure in most instances.

In Maryland, the recovery of the test strain was not increased significantly by increasing the level of inoculation from 25 times up to 800 times the standard amount. In contrast, recovery of test strains in Iowa increased progressively with progressive increases in the amount of inoculum applied.

The results were interpreted to indicate the possibility of selecting strains and improving inoculation procedures to enhance the success of inoculum.

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Soil-Plant-Animal Relationships

See Also 34, 92, 96, 98, 101, 183, 196, 197, 198, 214, 216, 219, 277, 295, 296, 297, 328, 333, 357.

112. Boatwright, G. O. EFFECT OF NITROGEN DEFICIENCIES ON SPRING WHEAT DURING THE EARLY STAGES OF PLANT DEVELOPMENT. *Proc. Ann. Fert. Conf. Pacific Northwest* 15: 131-140. 1964.

The effects of N deficiencies were studied during the early stages of plant growth of spring wheat on tiller and root development, dry matter yield, and N and P uptake.

Low levels of N in nutrient cultures during the first week of plant development reduced the number of tillers and secondary roots. Dry matter yields were not significantly reduced when 3.14 or 12.6 mg. of N were supplied for 1 week if adequate N was present thereafter. However, when adequate N was withheld for 2 weeks, yields were significantly lower than when adequate N was continuously supplied. Maximum P absorption occurred when inadequate N existed for the first week, provided adequate N was supplied thereafter. When P was omitted from a nutrient culture for the first 2 weeks, with adequate P supplied thereafter, increased P absorption resulted.

Total N uptake was significantly less when N was limiting for any period of time than when adequate N was continuously supplied. However, percentage N values were significantly higher. When N was withheld or inadequately supplied for the first 6 weeks, with a full supply thereafter, small amounts of N were absorbed and translocated to the tops between the 6th and 11th weeks of plant development. In contrast, it appears that little or no P translocation occurred after the sixth week of plant growth.

Root development during the first 4 weeks of plant growth was greater when N was limiting than when adequate N was supplied. Since top growth decreased, this indicates that the root system was stimulated at the expense of top growth.

SWCRD, ARS, USDA, Bozeman, Mont. 59715

113. Price, N. O., and Huber, J. T. MINOR ELEMENT CONTENT OF FORAGE PLANTS FROM THE SHENANDOAH VALLEY AND SOUTHWEST VIRGINIA. *Va. Agr. Expt. Sta. Tech. B.* 177, 15 pp. 1964.

From the Shenandoah Valley 155 forages and from southwest Virginia 76 forages were analyzed for minor elements--copper, cobalt, manganese, molybdenum, and zinc. The authors concluded that:

1. Assuming that 0.07 p.p.m. would be the minimum cobalt requirement for grazing animals, 55 percent of the grasses and 25 percent of the legumes from the Shenandoah Valley were deficient. Likewise, 58 percent of the grasses and 28 percent of the legumes from southwest Virginia were deficient in cobalt.
2. Assuming that 6.50 p.p.m. would be the minimum copper requirement for grazing animals, 63 percent of the grasses and 27 percent of the legumes from the Shenandoah Valley were deficient. From southwest Virginia 70 percent of the grasses and 69 percent of the legumes were deficient in copper.
3. The copper and cobalt contents of forages from the Shenandoah Valley showed the lowest copper levels in Augusta County and the lowest cobalt levels in Shenandoah County. Likewise, copper and cobalt contents of forages, non-legumes, and legumes from southwest Virginia show lowest levels in Russell County.
4. There appeared to be sufficient amounts of manganese, molybdenum, and zinc present in the legumes and non-legumes from both areas.
5. There were no great differences caused by soil types in the contents of these forages. However, some small areas reflected changes in forage contents which may be caused by soil conditions.
6. Based on available information regarding animal requirements and information obtained in these studies, it is unlikely that deficiencies of minor elements will occur in grazing animals, so long as mixed pastures of legume and non-legume plants are available to them.

Agr. Expt. Sta., Va. Polytech Inst., Blacksburg, Va. 24061

114. Nesheim, M. C., Leach, R. M., Jr., Zeigler, T. R., and Serafin, J. A. INTERRELATIONSHIPS BETWEEN DIETARY LEVELS OF SODIUM, CHLORINE AND POTASSIUM. J. Nutr. 84(4): 361-366. 1964.

A series of experiments were conducted on the dietary relationship of the cations, sodium and potassium, and the anions, chloride and sulfate. The data showed that excesses of dietary chloride or sulfate ions supplied as glutamic acid hydrochloride, calcium chloride, or calcium sulfate markedly depressed growth rate of chicks unless these anions were balanced with equimolar levels of sodium or potassium supplied in the diet with a metabolizable anion such as glutamate or carbonate. Excess sodium supplied as sodium glutamate was also detrimental unless a high level of chloride in one of the above forms was also present. Chicks tolerated excesses of potassium better than excesses of sodium.

Cornell U., Ithaca, N.Y. 14850

115. Foy, C. D., Burns, G. R., Brown, J. C., and Fleming, A. L. DIFFERENTIAL ALUMINUM TOLERANCE OF TWO WHEAT VARIETIES ASSOCIATED WITH PLANT-INDUCED pH CHANGES AROUND THEIR ROOTS. Soil Sci. Soc. Amer. Proc. 29(1): 64-67. 1965.

Differential Al tolerance of Atlas 66 and Monon wheat varieties in nutrient solutions and in acid Bladen soil was attributed, at least in part, to plant-induced differential pH changes around their roots.

In nutrient solutions, the Al-sensitive Monon variety lowered the pH and the Al-tolerant Atlas variety raised the pH, resulting in differences as large as 0.7 pH unit in the nutrient media. In acid Bladen soil, this difference was much smaller, and a high root-to-soil ratio was necessary to produce observed pH differences that were significant. The factor responsible for higher Al-tolerance of Atlas was not transferred to Monon in mixed cultures in Bladen soil.

U.S. Soils Lab., SWCRD, ARS, USDA, Beltsville, Md. 20705

116. Foy, C. D., and Burns, G. R. TOXIC FACTORS IN ACID SOILS. Plant Food Rev. 10(3): 2-3. 1964.

A recent greenhouse experiment with 13 acid soils from five Southern States showed that manganese toxicity was the first limiting factor in the growth of

alfalfa in eight soils, aluminum toxicity in one, calcium deficiency in one, and a complex of factors in three others.

In manganese-toxic soils, a primary function of lime is to reduce manganese solubility and in aluminum-toxic soils it is to reduce solubility of aluminum. In calcium-deficient soils, a primary function of lime is to supply needed calcium. The objective of a liming program should be to remove specific growth-limiting factors and not merely to raise the pH of the soil to some arbitrary value.

Plant species react quite differently to a particular toxic factor in acid soils. Alfalfa is severely injured by manganese toxicity on Zanesville soil and by aluminum toxicity on Bladen soil. And, it responds markedly to lime on both soils. An interesting difference between the Bladen and Zanesville soils is that at the same pH of 4.9, Bladen is high in aluminum and low in manganese, while the Zanesville is just the opposite.

Barley is extremely sensitive to high aluminum in Bladen soil but is much more tolerant to high manganese in Zanesville soil. Buckwheat, on the other hand, is relatively tolerant to both aluminum and manganese.

Liming acid soils to correct the first growth-limiting factor sometimes brings to light other limiting factors that must be corrected to obtain maximum yields. In addition to the hidden growth-limiting factors that may be unmasked by moderate liming, there are other growth-limiting factors that may be induced by heavy liming.

Acid soil problems are extremely complex, involving as they do excesses of certain elements, deficiencies or unavailabilities of others, or combinations of excesses and deficiencies. A practical approach is first to identify the growth-limiting factors and then to tailor both the plant and the liming practice to fit the specific soil problem.

U.S. Soils Lab., SWCRD, ARS, USDA, Beltsville, Md. 20705

117. Greenwood, D. A., Shupe, J. L., Stoddard, G. E., Harris, L. E., Nielsen, H. M., and Olson, L. E. FLUOROSIS IN CATTLE. Utah Agr. Expt. Sta. Sp. Rpt. 17, 86 pp. 1964.

Data from various controlled experiments at Utah State University were correlated with thousands of field case necropsies and examinations in an effort to evaluate fluorosis in cattle more effectively.

A detailed experiment on fluorosis in cattle was described and illustrated by photographs.

The tolerance level fluorine for lifetime (7.5 years) milk production was less than 55 p.p.m. on a dry-hay basis or 49 p.p.m. on a total dry-diet basis. No lactation effects were observed in animals receiving 27 or 28 p.p.m. F, indicating that the tolerance for lifetime (7.5 years) milk production is somewhere between 27 and 49 p.p.m. F on a total dry-diet basis, or 28 and 55 p.p.m. F on a dry-hay basis.

All fluoride residues in the milk were within safe levels for human consumption, although milk residues did increase with increased dietary fluoride intakes.

For shorter periods of time, such as for finishing meat animals up to 2 years of age, the fluorine tolerance level would be above 93 p.p.m. on a total dry-diet basis and 109 p.p.m. on a dry-hay basis.

Agr. Expt. Sta., Utah State U., Logan, Utah. 84321

118. Ensminger, L. E., Hood, J. G., and Willis, G. H. THE MECHANISM OF AMMONIUM PHOSPHATE INJURY TO SEEDS. Soil Sci. Soc. Amer. Proc. 29(3): 320-322. 1965.

Cotton and wheat seeds were soaked in various salt solutions (including ammonium phosphates) and allowed to germinate. With increasing salt concentration, the germination of cotton did not decrease, whereas the germination of wheat decreased in most cases. Soaking cotton seeds in 0.25 M $(\text{NH}_4)_2\text{SO}_4$ solutions adjusted pH levels between 7.2 and 9.0 and this showed germination injury above pH 7.8. The harmful effect of diammonium phosphate treatment was largely alleviated by subsequent soaking of seeds in dilute solutions of MgSO_4 . Germination injury from $(\text{NH}_4)_2\text{HPO}_4$ appeared to be largely due to the inactivation of Mg in seeds.

Agr. Expt. Sta., Auburn U., Auburn, Ala. 36830

119. Bingham, F. T., Bradford, G. R., and Page, A. L. TOXICITY OF LITHIUM TO PLANTS. Calif. Agr. 18(9): 6-7. 1964.

Competition for water in California between rapidly expanding industrial-urban activities and agriculture undoubtedly will lead to usage of waters of varying quality. Although standard criteria for water quality are at hand, they do not usually include a consideration of lithium--which may pose a hazard to certain plants. Lithium content may vary widely. Lithium injury in some citrus orchards had been associated with irrigation waters containing concentrations of 0.10 p.p.m. lithium or higher.

The table summarizes results of lithium rates producing mild toxicity symptoms.

TABLE, TOLERANCE OF PLANTS TO SOIL ADDITIONS OF LITHIUM SULFATE

Plant tested	Li range tested	Li rate producing 25% growth depression	Lithium content in tissue at 25% growth depression		
			Blade	Petiole	Root
	p.p.m.	p.p.m.	p.p.m.	p.p.m.	p.p.m.
Avocado	0-6	6	120	400	60
Soybean	0-20	7	40	40*	80
Sour Orange	0-6	8	180	ND*	50
Grape	0-16	12	300	450	400
Tomato	0-40	12	ND*	380	100
Red kidney bean	0-20	12	140	140	520
Cotton	0-40	25	1100	350	250
Dallisgrass	0-20	25	340		180
Red beet	0-80	35	5500	2200	90
Rhodesgrass	0-60	65	2400		205
Sweet corn	0-120	70	160	340	180
				(midrib)	

* No determination.

The test plants were classified as follows:

TOLERANCE TO LITHIUM

Very sensitive	Sensitive	Slightly sensitive	Tolerant
Avocado	Grape	Cotton	Rhodesgrass
Soybean	Red kidney bean	Dallisgrass	Sweet Corn
Sour orange	Tomato	Red beet	

The above tolerance classes closely parallel tolerance of plants to sodium.

U. Calif., Riverside, Calif. 92502

120. Crooke, W. M., Knight, A. H., and Keay, J. MINERAL COMPOSITION, CATION-EXCHANGE PROPERTIES AND URONIC ACID CONTENT OF VARIOUS TISSUES OF CONIFERS. Forest Sci. 10(4): 415-427. 1964.

Mineral and uronic acid (U.A.) analysis, and cation exchange capacity (C.E.C.) measurements were made on seedlings, pollen, and seed of 26 conifer species. Needles, stems, seed, and pollen had similar C.E.C. values averaging between 11 and 15 me./100 g., while those of roots ranged from 20 to 29 me./100 g., averaging 24 me./100 g. Cation exchange capacity and U.A. were positively related in all five tissues, while the mineral composition of the seedlings, all from the same granitic soil, showed little variation as far as major cations, P or S were concerned. Compared with the seedling tree, seeds contained similar amount of K and Na, but Ca and N were present in lower, and Mg in higher amount, and for pollen, Ca is much lower and K much higher than in vegetative tissues. Sequoia and Metasequoia needles had a very high Cl content relative to other species.

Compared with the good positive correlations found for Angiosperm species, connecting root C.E.C. with ash, total cations, or CA + Mg/K + Na in the tops, those derived from the conifer data were poor. For 20-year-old trees of Pinus contorta

grown in a replicated experiment in Scotland from seed from 10 sources in western Canada and U.S.A., the C.E.C. of needles ranges from 8.6 to 9.7 me./100g., and correlated with their N content ($r = 0.88$). Nitrogen content, needle weight, and length were positively related and increased with distance from the coast of the seed collecting area. For seed from intermediate and inland sources, these characteristics increased with height of the collecting area above sea level. For the other chemical constituents very little variation was found between the 10 provenances.

Macaulay Inst. Soil Res., Aberdeen, Scotland.

121. Labanauskas, C. K., Stolzy, L. H., Klotz, L. J., and DeWolfe, T. A. EFFECTS OF SOIL TEMPERATURE AND OXYGEN ON THE AMOUNT OF MACRONUTRIENTS AND MICRONUTRIENTS IN CITRUS SEEDLING (CITRUS SINENSIS var. BESSIE). Soil Sci. Soc. Amer. Proc. 29(1): 60-64. 1965.

Experiments were conducted in a greenhouse during both fall and spring to study the influence of soil oxygen conditions and soil temperatures on the amounts of macro- and micro-nutrients in sweet orange seedlings (Citrus sinensis var. Bessie).

The total amounts of 11 nutrients and Na were determined in the roots and tops of citrus seedlings. Slight soil temperature affected the dry weight of plants and the amounts of nutrients in K, Cl, and B found in the tops of plants grown at the higher soil temperature than at the lower.

The amounts of N, P, K, Ca, Mg, Zn, Cu, Mn, B and Fe decreased in the citrus seedlings with decreasing soil oxygen supply to the roots. The chloride and Na content decreased the roots and increased in the tops with decreasing soil-oxygen supply to the roots of the seedlings.

Citrus seedlings grown during the fall months produced more dry weight of plants, and contained larger amounts of nutrients per plant, except Na and Cl, than seedlings grown during the spring months.

U. Calif., Citrus Res. Cent. and Agr. Expt. Sta., Riverside, Calif. 92502

122. Pumphrey, F. V., and Moore, D. P. SULFUR AND NITROGEN CONTENT OF ALFALFA HERBAGE DURING GROWTH. Agron. J. 57(3): 237-239. 1965.

Alfalfa fertilized with gypsum at rates of 0, 10, 20, and 40 lb. of S/A. was sampled at 10- to 14-day intervals during the growth of the first cutting. Yield, percent S, and percent N in the herbage were determined for each treatment at each sampling. Data obtained indicated the following:

1. Percent S and N were highest in the youngest growth and steadily declined as the herbage grew to the full-bloom stage.
2. Sulfur fertilization of S- deficient alfalfa increased the percent S and N in the herbage, as well as the yield.
3. The rate of decrease in percent S in the plant during growth was essentially independent of sulfur fertilization.
4. The use of a percent S in alfalfa herbage as a critical level needs to be associated with a definite stage of growth.
5. The N to S ratio in the herbage was relatively constant during the growth of the first cutting.
6. The N to S ratio was much narrower in nondeficient than in sulfur deficient herbage.

Oreg. Agr. Expt. Sta., Oregon State U., Corvallis, Oreg. 97331

123. Jurgensen, M. R. and Leaf, A. L. INTERACTIONS RELATED TO GROWTH AND NUTRIENT UPTAKE OF RED PINE. Soil Sci. Soc. Amer. Proc. 29(3): 294-299. 1965.

A 26-year-old red pine plantation (Pinus resinosa Ait.) supported by Carver coarse sand at 0 to 18 feet above lake level on a peninsula was fertilized with 100 lb./A. of K in 1952. Soil moisture-fertility relationships associated with tree growth and nutrient uptake were examined by: (1) Total tree chemical composition; (2) soil chemical analysis; (3) soil moisture availability; (4) ground water influence including chemical components; and (5) tree responses to K fertilization. Soil moisture-fertility interactions on tree development were related to depth of

ground water: (1) Tree height growth, needle area/A., content of nutrients, and foliar K concentrations were inversely related to ground water depth; (2) tree growth response to K fertilization was directly related to ground water depth.

State U. Col. Forestry, Syracuse U., Syracuse, N.Y. 13201

124. Youngberg, C. T., and Dyrness, C. T. BIOLOGICAL ASSAY OF PUMICE SOIL FERTILITY. Soil Sci. Soc. Amer. Proc. 29(2): 182-187. 1965.

The fertility of pumice soils is difficult to assess by laboratory analysis. A biological assay of growth responses yields more meaningful information. Four pumice soils common in central Oregon were assayed in the greenhouse using ponderosa pine as an indicator species.

A composite experimental design was used involving additions of N, P, K, Ca, and S. There were no responses to either K or Ca. Nitrogen appeared to be the most deficient nutrient element since it was the only one tested that gave large responses when added alone. Combinations of N and P and N and S gave better responses than N alone. Best growth resulted from additional of N, P, and S in combination.

Oreg. Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg. 97331

125. Jackson, T. L., Rampton, H. H., and McDermid, J. THE EFFECT OF LIME AND PHOSPHORUS ON THE YIELD AND PHOSPHORUS CONTENT OF LEGUMES IN WESTERN OREGON. Oreg. Agr. Expt. Sta. Tech. B. 83, 24 pp. 1964.

The effect of lime and phosphorus on forage production and phosphorous content of six different legume species was evaluated on two of the major soil series in the Willamette Valley, Oreg., alfalfa, birdsfoot trefoil, white clover, red clover, crimson clover, and subterranean clover were the legumes evaluated on Willamette and Olympic soil series.

Alfalfa was the highest yielding species on both locations, followed by birdsfoot trefoil, red clover, subterranean clover, crimson clover, and white clover on Willamette soil, and by subterranean clover, birdsfoot trefoil, red clover, crimson clover, and white clover on Olympic soil. Alfalfa was the only legume to show a marked response to lime on the Willamette soil. There was no response to phosphorus on Willamette soil.

There were four different patterns of lime x phosphorus interactions on Olympic soil. Application of lime was essential for the production of alfalfa on Olympic soil; there was little response from phosphorus on alfalfa.

On Olympic soil, birdsfoot trefoil showed response from both lime and phosphorus the first year with the response from both becoming smaller as the stand aged. The yield from the plots without lime or phosphorus increased with the age of the planting.

Subterranean clover showed a marked lime x phosphorus interaction on Olympic soil. Six-thousand pounds were produced from application of either phosphorus or lime. Maximum yields were produced with a combination of lime and phosphorus or the 6-ton rate of lime.

A significant lime x phosphorus interaction was evident each year with white clovers on Olympic soil. Maximum yield was maintained with the 3-ton rate of lime plus 60 pounds of phosphate (P_2O_5) per acre each year. The white clovers yielded less than other legumes species evaluated.

There were wide differences in response from lime on the two soils evaluated, with small difference in soil pH.

The phosphorus contents of forage from the Willamette soil and the calcium contents of forage from both locations were well above the critical levels suggested for these nutrients. The calcium contents of the forage were higher from the Olympic soil while the phosphorus contents were higher from the Willamette soil.

Tables and graphs.

Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg. 97331

126. Engelstad, O. P., and Moreno, E. C. EFFECT OF P CONCENTRATION AND DISTRIBUTION OF P UPTAKE AND ROOT GROWTH OF CORN. Soil Sci. 99(4): 227-233. 1965.

A series of experiments was conducted to study the effects of P concentration and distribution on plant growth and P uptake, as influenced by variation in water solubility of P fertilizers.

Accumulation of P was constant per unit weight of intact corn roots in contact with solutions containing 15, 30, and 60 p.p.m. of P. The accumulation of P in the tops, however, was significantly higher for those plants having roots in contact with the more concentrated solution of P.

A greenhouse pot experiment, in which the distribution of P from applied fertilizers of high-water solubility (monocalcium phosphate) and low-water solubility (dicalcium phosphate) was restricted to a uniform volume of soil, indicated no differences in dry-matter yield or P uptake from the two P sources. An accompanying experiment in which distribution of P from granules of the same P fertilizers was unrestricted in volume showed much greater dry-matter yield and P uptake in the case of the water-soluble source.

An additional greenhouse pot experiment was conducted with the same P fertilizers placed in concentrated bands located in the top, middle, and bottom of the pots to study the effect of P concentration on root development. The much higher concentration of P in the vicinity of the band of monocalcium phosphate appeared to markedly stimulate root and top growth.

TVA, Wilson Dam, Ala. 35660

127. Smith, C. B., Chubey, B. B., and Curwen, D. YIELD, VIGOR, MATURITY, QUALITY, AND LEAF COMPOSITION OF SWEET CORN AS INFLUENCED BY DIFFERENTIAL FERTILIZER TREATMENTS. Pa. Agr. Expt. Sta. B. 710, 28 pp. 1964.

Differential sweet corn fertilizer experiments were carried out in Pennsylvania in 1958-59. A partially confounded 3 by 3 by 3 factorial design with three levels of each of nitrogen, phosphorus, and potassium in all possible combinations was used, giving 27 fertilizer treatments and a total of 486 plots. Fertilizers were applied using a combined broadcast and banded placement at rates of 36, 126, and 216 lb./A. of nitrogen, phosphoric acid, and potash. The Iochief hybrid was thinned to a uniform stand of 16,000 plants per acre.

Soil fertility and nutrient-element absorption were studied by four-factor soil analyses and eight-element leaf analyses. Plant responses studied included total yield, filling of ears, emergence, barren plants, mature height, 50-day height (1959 only), maturity (silking and succulence), ear size, and cut off.

Higher rates of phosphorus fertilizer produced most of the favorable responses. Yield responses varied between locations, but at four locations the 126 lb./A. rate gave a probable economic return while at three locations the 216 lb./A. rate gave an additional probable economic return. In addition, increasing levels of phosphorus had the following significant effects: Increased percentage of well-filled ears; decreased percentage of small ears; markedly decreased percentage of barren plants; hastened maturity; and increased vigor, ear weight, and cut off. Leaf analyses showed that phosphorus increments significantly increased the concentrations of phosphorus, calcium, and manganese, while reducing the copper content.

The application of nitrogen increments produced relatively small effects. Only the 126 lb./A. level gave a probable economic yield return and then only at two locations. Other significant effects of increasing nitrogen levels included decreased percentage of poorly filled ears, decreased emergence and vigor, and delayed maturity. Leaf analyses revealed that increased nitrogen levels increased the absorption of nitrogen, calcium, manganese, copper, and boron.

No favorable yield responses were obtained from potassium applications. Potassium increments produced several unfavorable effects, including decreased percentage of well-filled ears and increased percentage of poorly filled ears. Leaf composition was markedly affected by potassium increments, including increased potassium absorption and depressed adsorption of phosphorus, calcium, magnesium, copper, and boron. The absorption of calcium and magnesium was consistently restricted at each site by each potassium increment.

Pa. State U., Col. Agr., Agr. Expt. Sta., University Park, Pa. 16802

128. Joham, H. E., and Amin, J. V. ROLE OF SODIUM IN THE POTASSIUM NUTRITION OF COTTON. Soil Sci. 99(4): 220-226. 1965.

Cotton plants (variety Deltapine 15) were grown in nutrient solutions. When the plants were 38 days old, they were subjected to treatments employing four possible combinations of plus and minus potassium and sodium. A partial substitution of sodium for potassium occurred and was evident in the fruiting activity, percent leaf hydration, leaf protein, and soluble nitrogen fractions.

The influence of potassium deficiency on the nitrogen metabolism of cotton leaves depended to a large extent on the sodium supply. Potassium deficiency in the presence of high substrate sodium caused amino acids to accumulate in the leaves but had no significant influence on leaf protein, nitrate nitrogen, ammonia nitrogen, or urea. Potassium deficiency in the absence of added substrate sodium resulted in an accumulation of amino acids and urea, and a decrease in leaf protein. Urease activity was inversely related to potassium deficiency and independent of sodium nutrition. With the exception of reducing sugars in the stems of 60-day plants, carbohydrate concentrations of the various tissues were independent of nutrient treatment.

Tex. A&M U., College Station, Tex. 77843

129. Bennett, O. L., Rouse, R. D., Ashley, D. A., and Doss, B. D. YIELD, FIBER QUALITY AND POTASSIUM CONTENT OF IRRIGATED COTTON PLANTS AS AFFECTED BY RATES OF POTASSIUM. Agron. J. 57(3): 296-299. 1965.

Field studies were conducted over a 2-year period (1960-61) on a Faceville sandy loam soil at Thorsby, Ala., to determine the effects of rates of K on yields, fiber quality, and K content of irrigated cotton. Annual rates of K were 0, 62.5, 125, 250, 325, and 500 pounds per acre.

Yields of seed cotton were increased by rates of K, with a similar yield response for both years. Maximum yields of seed cotton for each year were approximately 5,000 pounds per acre.

Potassium content of cotton plants was directly related to rates of K applied. Old leaves plus petioles had the widest range in percent K and, therefore, gave the best indication of the plant. Most of the potassium in the plants was found in the stems and old leaves plus petioles by mid-July. In mid-August, the fruit contained more total K than other plant parts. At rates below 250 pounds, more K was found in the aboveground portion of the plants than was applied.

As rate of K was increased, there was an increase in the amount of boll rot, size of bolls, and final height of plants. High rates of K delayed maturity. Fiber quality, as indicated by micronaire, fiber length, and fiber strength, was best at the 62.5- and 125-pound rates of K.

SWCRD, ARS, USDA, Morgantown, W. Va. 26500

130. Longenecker, D. W., Thaxton, E. L., and Lyerly, P. J. NUTRIENT CONTENT AND NUTRIENT RATIOS OF IRRIGATED COTTON ON FERTILE SOILS: AS AFFECTED BY IRRIGATION FREQUENCY, WATER QUALITY AND OTHER FACTORS. Tex. Agr. Expt. Sta. Misc. P. 728, 11 pp. 1964.

Analyses of Acala cotton tops and roots from four combination fertility-irrigation tests over a 2-year period in West Texas were reported. The effects of irrigation frequency, stage of plant growth, type of soil colloid, and quality of irrigation water on plant tissue concentrations of eight mineral nutrients and sodium were discussed. Some hypothetical nutrient ratios were calculated on an equivalent basis.

Uptake of specific nutrients on these fertile irrigated soils differed somewhat with location, but were generally fairly comparable. Relative top-root ratios for specific ions showed great variation. Chief factors governing uptake appeared to be selective root absorption against external concentration gradients and available mineral content of soils and irrigation waters. Nature of the soil colloid apparently was of minor importance.

Soil moisture content had little effect on uptake of any of the nutrients studied.

Most of the hypothetical plant nutrient ratios varied considerably either with location or stage of plant maturity. However, three of these (Na/K, Na/Ca, Na/Ca = Mg) showed good stability and may prove useful as measures of relative nutrient uptake or possible nutrient deficiencies in cotton on calcareous soils.

Top and root nutrient concentrations reported can be assumed to be essentially equilibrium (if not optimum) concentrations, since absorption and translocation occurred under growth conditions in which all of the nutrients were available in ample or excess quantities.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843

131. Cook, C. W., Kothmann, M., and Harris, L. E. EFFECT OF RANGE CONDITION AND UTILIZATION ON NUTRITIVE INTAKE OF SHEEP ON SUMMER RANGES. J. Range Mangt. 18(2): 69-73. 1965.

During three summers from 1960-62, a study was conducted on mountainous summer ranges of northern Utah to determine the effect of range condition and intensity of grazing upon the daily intake, nutritive content, and digestibility of the grazing sheep's diet. Five areas displaying fence-line contrasts of good and poor range condition were selected and fenced so that each side included equal amounts of herbage.

Ranges in poor condition produced slightly more total herbage than adjacent ranges in good condition. Good ranges produced more grass but utilization of grasses was higher on adjacent poor ranges. Both production and utilization of browse were greater on poor ranges than on good ranges.

Grass and forbs increased in the diet with increased utilization, but browse decreased in the diet as degree of range utilization increased.

Total protein, other carbohydrates, and gross energy in the diet decreased with increased grazing intensity; whereas, ash, cellulose, and lignin contents increased.

The average digestibilities of cellulose, other carbohydrates, and gross energy in forage from both good and poor ranges decreased with heavier utilization. On good range, the digestibility of total protein was not affected by increased utilization, but on poor range it decreased significantly.

Total digestible nutrients in the forage decreased on both good and poor ranges with increased utilization, but the decrease was much less on good range.

Daily forage intake increased slightly during the second grazing period on good range but decreased somewhat during the second period on poor range. Range condition had no significant influence on daily intake.

Wether sheep weighing about 135 pounds at the beginning of the trials gained an average of 28 pounds for the summer grazing season on good range and only 17 pounds on poor range.

Utah State U., Agr. Expt. Sta., Logan, Utah. 84321

132. Davis, C. R., Morgan, G. W., and Howell, D. R. SULPHUR DIOXIDE FUMIGATION OF COTTON AND ITS EFFECT ON FIBER QUALITY. Agron. J. 57(3): 250-251. 1965.

The influence of SO₂ fumigation of cotton plants on fiber quality and ginning percentage was studied in an experiment consisting of 111 whole plots (222 subplots) of properly irrigated cotton, and 15 whole plots of water-stressed cotton. The plants were lightly to moderately defoliated with sulphur dioxide.

The yield of cotton was tested for influences of the treatment of fiber grade and staple length together with the influences on the ginning percentage. A statistically significant increase due to fumigation was found in grade and staple length on the first picking, with a non-significant difference due to treatment on the second and third pickings. No significant differences due to fumigation were found for the ginning percentage.

Phelps Dodge Corp., Douglas, Ariz. 85607

133. Ramig, R. E. PROTEIN CONTENT OF WHEAT AS AFFECTED BY SOME AGRONOMIC PRACTICES. Proc. Ann. Fert. Conf. Pacific Northwest 15: 51-60. 1964.

Optimum yields of wheat were obtained with 80 pounds of nitrogen per acre on a deep Walla Walla silt loam in a 16-inch annual rainfall zone and with 40 pounds of nitrogen per acre on a deep Ritzville silt loam in an 11-inch annual rainfall zone.

The quantity of grain protein increased as rates of nitrogen fertilizer were increased. The increase in grain protein was greater and yield level lower on the Ritzville soil than on the Walla Walla soil in the higher rainfall zone.

There was a distinct climatic effect on the protein content of the grain. Generally, grain protein will be low when rainfall and yield level are high. In this study, yield level and protein were low when crop-year precipitation was high but rainfall in the May-July period was low. Low-mean temperatures during the ripening period in 1963 and stripe rust probably contributed to the low protein of the grain that year.

The protein content of wheat increased with lateness of seeding date to November 1.

Brevor, a variety of soft white wheat, had a higher protein content than Gaines, a soft white wheat, or Omar, a white club variety. There was little difference between the protein contents of Gaines and Omar.

SWCRD, ARS, USDA, Pendleton, Oreg. 97801

134. Adams, R. S., Jr. PHOSPHORUS FERTILIZATION AND THE PHYTOTOXICITY OF SIMAZINE. Weeds 13(2): 113-116. Apr. 1965.

In greenhouse experiments, high levels of phosphorus tended to suppress growth of soybeans, oats, and foxtail in the presence of simazine as compared to controls containing no simazine. However, this relationship was not significant, varying with the soil used in the experiment. Emergence of the seedling was delayed and the concentration of ions in solution increased as phosphorus applications were increased. Mineral uptake by soybean shoots was unaffected by phosphorus or simazine alone, but markedly disrupted in the presence of both simazine and phosphorus. Changes in mineral uptake were typical of effects produced by phosphorus toxicity, indicating that simazine reduced the amount of phosphorus required to produce salt injury.

U. Minn., St. Paul, Minn. 55101

Soil Classification

See Also 48, 49, 50, 51, 53, 62, 64, 68, 71, 72, 85, 95, 100, 101, 102, 103, 105, 115, 116, 123, 124, 125, 129, 133, 156, 172, 173, 177, 183, 192, 194, 195, 197, 211, 230, 232, 245, 246, 253, 270, 353.

135. Falini, F. ON THE FORMATION OF COAL DEPOSITS OF LACUSTRINE ORIGIN. Geol. Soc. Amer. B. 76(12): 1317-1346. 1965.

A quantitative theory of the origin of lacustrine coal deposits was studied.

The accumulation of peat, dozens of feet thick, was required to form an exploitable coal measure; this implies a long rise of water level at rates not exceeding 10 to 20 cm. per year. When the relationship between water level and time was analyzed for lacustrine basins, the amount of peat accumulating under different conditions could be predicted. In general, the larger the water inflow, the greater the thickness and volume of accumulated peat. The shape of the basin was a modifying factor.

The ash content usually increased from the bottom upward in an individual layer. Consideration of shrinkage under load gave a relationship between ash content and maximum possible thickness of a peat seam. As the thickness of peat increased, there was a maximum thickness of partings beyond which the peat deposition was permanently interrupted.

Because of the influence of climatic variations, peat formation may start in dry periods earlier than predicted by the approximate theory; reciprocally, peat formation in rainy periods can be interrupted even when average conditions are

favorable. This explains why the thickness of the lignite seams in lacustrine basins was generally small in the lower part of the series but increased toward the top.

Deceased

136. McKeague, J. A. A LABORATORY STUDY OF GLEYING. *Canad. J. Soil Sci.* 45(2): 199-206. June 1965.

Columns of different soil materials with ground leaves at the surface were maintained for 18 months with the water table continuously above the surface, or fluctuating between the surface and 15 cm. Redox potentials, colors, and extractable iron were determined. The effects of temperature and of organic matter on the rate of change of E_h were studied with flooded soils in test tubes.

The rate and degree of development of dull colors and mottling in the soil columns were influenced greatly by the nature of the soil material. Reduction effected marked increases in acetic acid extractable iron from all of the soil materials. Low redox potentials developed rapidly at room temperature in flooded soils containing appreciable amounts of organic matter. E_h values below 0 mv developed slowly in soils at 1° C. and at room temperature in some soils that were almost devoid of organic matter. Release of Fe^{+2} from ferrous minerals was thought to account for these low E_h values.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Canada.

137. Bornstein, J., Bartlett, R. J., and Howard, M., Jr. DEPTH TO FRAGIPAN IN CABOT SILT LOAM--VARIABILITY IN A CHARACTERISTIC AREA. *Soil Sci. Soc. Amer. Proc.* 29(2): 201-205. 1965.

A drainage research project was established at East Franklin, Vt., on a Cabot silt loam to study and improve interception drainage methods. To be able to interpret the resulting data with greater meaning, it was necessary to determine the variability of depth to fragipan and the relations between this variability, the slope of the surface, and the thickness of the A_p horizon. Two methods of determining depth to the fragipan surface were used. The more feasible one, auger borings taken on a 100-foot grid was evaluated for precision in relation to the method of examining drain trench walls. Thickness of A_p horizon and the depth to the fragipan surface were measured at 161 locations 2 feet apart along tile drain trenches. Fragipan surface at 143 points over the research area was located by the auger grid system.

The mean depth of the A_p horizon was 7.4 inches, and 83 percent of the measurements fell in the 6- to 9-inch range. Of all fragipan depths, 74 percent were in the 11- to 17-inch range. Mean depth by augering was 13.9 inches; along the trench profile it was 14.4 inches. In this area of Cabot silt loam, the lower boundary of the A_p and the fragipan surfaces generally follow surface slopes. The auger method data followed the trend of the measurements derived from the trench profile.

SWCRD, ARS, USDA, Burlington, Vt. 05401

138. Burst, J. F. SUBAQUEOUSLY FORMED SHRINKAGE CRACKS IN CLAY. *J. Sedimentary Petrology.* 35(2): 348-353. 1965.

Several laboratory experiments confirmed that shrinkage cracks can develop on and through a surface composed of naturally occurring materials which has been continuously covered by water. Shrinkage cracking was ascribed to the contraction of swelling clay lattices in response to a drastic change in the salinity of the surrounding liquid phase.

From a geologic point of view, the experiment suggests that mud cracks can develop in a recent fresh-water mud deposit that contains a quantity of swelling clay by the simple process of salt water influx and without an intermediate exposure to air. The fact that the necessary bulk-volume change has been brought about by leaching the clay with artificial sea water for only a few days suggests that the transition could result from seasonal salinity changes in lagoonal, tidal channel,

and nearshore marine areas, where the salinity is highly affected by surface run-off.

Shell Develop. Co., Houston, Tex.

139. Ruhe, R. V., Williams, J. M., Shuman, R. C., and Hill, E. L. NATURE OF SOIL PARENT MATERIALS IN EWA-WAIPAHAU AREA, OAHU, HAWAII. Soil Sci. Soc. Amer. Proc. 29(3): 281-287. 1965.

Soil parent materials in the Ewa-Waipahu area, Oahu, Hawaii, occur in three landscape groups. Wahiawa Basin has more acid materials with high iron and manganese oxide content dominated by kaolinitic clay. Ewa coastal plain sediments are alkaline with lower oxide amounts but appreciable calcium carbonate and are dominated by 2:1 lattice clay. Between these two areas is the Kaloi surface with associated sediments whose properties are intermediate in composition.

Materials of the groups differ in origin and age. Wahiawa Basin materials are pre mid-Pleistocene products of in situ weathering of basalt or locally derived basaltic detritus. Ewa coastal plain sediments of mid-Pleistocene age are products of terrestrially derived detritus from basaltic terrain that was deposited in a near shore marine environment. Kaloi sediments are late Pleistocene detritus both derived and deposited terrestrially. Soils formed in the materials inherit some of the geomorphically evolved parent material differences.

SCS, USDA, Washington, D.C. 20250

140. Grimes, M. F., and Arneman, H. F. THE CHARACTERIZATION OF SOME SOILS DEVELOPED FROM MIXED BROWN AND GRAY TILLS IN CENTRAL MINNESOTA. Soil Sci. Soc. Amer. Proc. 29(1): 84-88. 1965.

Superposition and interbedding of various glacial drifts of the Wisconsin age are common in central Minnesota.

Morphological characteristics of soils developed from calcareous gray till (Hayden series), noncalcareous brown till (Flak), and from mixed tills (Holdingford) were shown in the profile descriptions. The series were characterized in the laboratory by pebble identification, particle size distribution, bulk density, moisture holding capacity, total exchangeable cations, exchangeable calcium, magnesium, and hydrogen, percent base saturation, pH, and C/N ratio.

The characterization of the profiles studied showed definite morphological, physical, and chemical differences between the soils developed from the mixed tills and those from the unmixed modal brown or gray tills. The study showed the need for a series separation between these soils.

SCS, USDA, St. Cloud, Minn. 56301

141. Nimlos, T. J., and McConnell, R. C. ALPINE SOILS IN MONTANA. Soil Sci. 99(5): 310-321. 1965.

Alpine soils in Montana were described and analyzed as part of a study to characterize the alpine ecosystem. Three soil series, two well-drained and one poorly drained, were described. The well-drained series--Ptarmigan on siliceous rocks and Snowy on calcareous rocks--have in common an organic surface horizon, called a turf, which is tightly enmeshed by numerous fine roots. Beneath the turf is an A₁ horizon that has the characteristics of a mollie epipedon, low C/N ratios, dark colors, and high base saturation. The Ptarmigan series immediately above the tree line has a spodic (B_{1p}) horizon whose chroma decreases with increasing elevation. The epipedon in the Snowy series lies directly on calcic horizons. The genesis of well-drained alpine soils is primarily an incorporation of organic matter in the surface horizon with some sesquioxide and humus eluviation in acid materials and some recrystallization of the carbonates in calcareous materials.

The poorly drained series (Vasquex) is formed in acid materials. The epipedon is histic and the profile is strongly acidic. Evidence of gleying exists in the profile. The genesis of this soil is typical of other soils with impeded drainage: stagnation of the organic matter on the surface, due to low oxidation rates caused

by low temperatures and poor aeration, and reducing conditions predominating, as evidenced by gleying and mottling.

Mont. State U., Bozeman, Mont. 59715

142. Knox, E. G. SOIL INDIVIDUALS AND SOIL CLASSIFICATION. Soil Sci. Soc. Amer. Proc. 29(1): 79-84. 1965.

The standing of eight kinds of soil bodies as soil individuals was evaluated in the light of the following principles, derived from an analysis of basic ideas: (1) Classes are abstract fields, not groups of individuals; (2) artificial individuals of continuous universes are different from natural individuals of particulate universes; (3) classes in continuous universes are independent of individuals; and (4) artificial individuals are member-bodies of minimum size.

Soil particles, soil horizons, soil landscape units (including polypedons), and delineated soil bodies are natural individuals, but only within nonsoil universes. The universes of soil resulting from any of the common concepts of soil as an isotropic material or an anisotropic body are continuous, and contain hand specimens, soil profiles taken as bodies, "individuals", and pedons as artificial individuals. These may be regarded as soil individuals. There is need for a concept of soil corresponding to some kind of soil landscape unit.

Oreg. State U., Corvallis, Oreg. 74075

143. Drew, J. V., and Eikleberry, R. W. USING PUBLISHED SOIL SURVEYS IN TEACHING SOIL CLASSIFICATION AND MAPPING. Agron. J. 57(3): 305-308. 1965.

Recently published soil surveys may be used effectively as laboratory workbooks in teaching soil classification and survey. Soil descriptions and laboratory characterization data included in these surveys are useful in illustrating similarities and differences among soils. Certain surveys illustrate broad areas of soils that have formed under the dominant influence of climate and vegetation, whereas other surveys illustrate extensive areas of soil that reflect parent materials, relief, or land surface age as dominant factors of soil formation. Surveys of mountainous areas provide examples of soil patterns resulting from a vertical zonation of climate and vegetation. In addition, recent surveys demonstrate the relationships of soil mapping unit patterns to a variety of land forms, soil parent materials, and Pleistocene events. Each survey also provides examples of the interpretation of standard soil surveys for a number of uses.

U. Nebr., Lincoln, Nebr. 68503

144. Fenzl, R. N., and Levine, G. MAPPING SOILS ACCORDING TO TOTAL AVAILABLE MOISTURE CAPACITY THROUGH AERIAL PHOTOGRAPHY INTERPRETATION. Trans. ASAE 8(2): 301-304. 1965.

The interpretation of stereoscopic aerial photographs is a recognized means of soil investigation and mapping. The effectiveness of photo interpretation as a means of estimating the total available moisture capacity of soils was investigated. Soil samples were obtained from an initial study area in south central New York, and available moisture-capacity values were determined by measuring the one-third and 15-atmosphere tension moisture equilibrium points. This information was used to define the features appearing in the aerial photography that might serve as criteria for making quantitative estimates of capacity.

The reliability of this method was evaluated by mapping soil units of the basis of available moisture capacity in six check areas near that of the preliminary study. Capacity values estimated by the interpretive procedure were then compared with those from soil samples. Under some, but not all of the situations tested, the method allowed differentiation between soils with unlike capacities. The precision in assigning quantitative values to the soil units was related to the amount of ground control available to the interpreter. Results were most satisfactory where changes in soil properties were linked with changes in topography, drainage, and vegetation.

U. Ill., Urbana, Ill. 61803

EROSION CONTROL

Wind and Water Erosion

See Also 7, 9, 10, 11, 13, 23, 160, 161, 162, 173, 201, 203, 204, 252.

145. Task Committee on Preparation of Sedimentation Manual; Committee on Sedimentation. SEDIMENT TRANSPORTATION MECHANICS: WIND EROSION AND TRANSPORTATION; PROGRESS REPORT. J. Hydraul. Div., ASCE 91 (HY 2): 267-287. 1965.

The mechanics of wind erosion is a broad, complex subject. The transport of soil material by wind is a special case of the broader field of the transport of solids by fluids. Certain fundamental and relatively great differences exist, however, between the transport of material by wind as compared to its transport by water. For example, soil as it is exposed to wind erosion is made up of solid, liquid, and gaseous components whereas soil exposed to water erosion is made up principally of solid and liquid components. The greatest fundamental difference between air and water transportation, however, is associated with the difference in density of the fluid media. Such variables as wind, surface, topography, soil, and surface effects must be studied to gain a picture of the wind erosion problem. Beginning with the von Karman-Prandtl equation, this report examined the existing knowledge in this area of sediment transportation mechanics.

No address given.

146. Task Committee on Preparation of Sedimentation Manual; Committee on Sedimentation. SEDIMENT TRANSPORTATION MECHANICS: NATURE OF SEDIMENTATION PROBLEMS; PROGRESS REPORT. J. Hydraul. Div., ASCE 91 (HY 2): 251-266. 1965.

Sedimentation embodies the processes of erosion, entrainment, transportation, deposition, and the compaction of sediment. These are natural and complex processes that have been active throughout geological times and have shaped the landscape. The principal external dynamic agents of sedimentation are water, wind, gravity, and ice. Only hydrospheric forces were considered in the manual. The damages created by sediment are varied and extensive and depend on the amount and character of sediment, which, in turn, is influenced by the processes of erosion, transport, and deposition. Much useful information is presently available on these processes and will be presented in subsequent chapters of this manual.

No address given.

147. Willen, D. W. SURFACE SOIL TEXTURAL AND POTENTIAL ERODIBILITY CHARACTERISTICS OF SOME SOUTHERN SIERRA NEVADA FOREST SITES. Soil Sci. Soc. Amer. Proc. 29(2): 213-218. 1965.

Analyses of texture and potential erodibility were made on 208 samples of residual, upland forest soils collected at elevations from 6,500 to 8,000 feet in the southern Sierra Nevada in California. Multiple regression tests showed that soil texture and erodibility indexes were significantly related to variation in parent rock type, vegetative cover types, aspect, slope, and elevation. Prediction equations implied that granitic forest soils at high elevations may be twice as erodible as soils developed under similar soil forming conditions at low elevations.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif. 94701

148. Aldon, E. F. GROUND-COVER CHANGES IN RELATION TO RUNOFF AND EROSION IN WEST-CENTRAL NEW MEXICO. U.S. Forest Serv. Res. Note RM-34, 4 pp. 1964.

In 1952, a cooperative study on three San Luis experimental watersheds in New Mexico was begun to determine the feasibility of restoring the more deteriorated portions. Grazing management was started, but full control of the livestock through overwinter use only was not achieved until 1958. The periods 1952-58 and 1959-62 were examined to determine the effect this different grazing use had on sediment yield, surface runoff, and ground cover.

Before the uniform grazing treatment, average ground cover, measured by three key grass species, ranged from 3 to 5 percent on the watersheds. Three years later the percentages had doubled: they ranged between 6 and 12 percent; bare ground decreased. Runoff during periods was similar although the precision of the measurements was such that small changes could not be detected. Sediment production decreased between 0.2 and 0.7 acre-foot per year on the watersheds. The changes may be attributable to the change in grazing use between periods. Ground cover improved under summer-deferred grazing and fencing. Precipitation averages during the two periods were similar.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo. 80521

149. Meyer, L. D. SIMULATION OF RAINFALL FOR SOIL EROSION RESEARCH. Trans. ASAE 8(1): 63-65. 1965.

Most soil erosion by water occurs during and immediately following a relatively few rainstorms, which may occur almost any time. Erosion research under such conditions has numerous disadvantages. Therefore, simulated rainfall has become an important research tool for erosion studies. It is generally more rapid, efficient, controlled, and adaptable than natural rainfall. It can, therefore, replace natural rainfall for many studies, and it is an essential part of laboratory erosion research. However, rainfall is very difficult to simulate, and relatively elaborate equipment and methods are usually required for satisfactory results. Furthermore, the limitations of simulated rainfall must be recognized, and results from simulated rainfall research must be judiciously applied.

Simulated rainfall is not a magic method for solving all erosion research problems. However, combined with past and continuing results from long-term natural rainfall studies, simulated rainfall is a valuable research tool having the potential for greatly improving our knowledge of soil erosion.

SWCRD, ARS, USDA, Lafayette, Ind. 47907

Strip Cropping

See 201

Terracing

See Also 10, 163, 233.

150. Mitchell, J. K., and Beer, C. E. EFFECT ON LAND SLOPE AND TERRACE SYSTEMS ON MACHINE EFFICIENCIES. Trans. ASAE 8(2): 235-237. 1965.

A study was made to define quantitatively the effect of land slope and field configuration on the field performance of farming operations and the reduction in plant population after cultivation. The results were used to determine the relative effect of conventional, parallel, and bench-terrace systems on the time required for farming operations.

Comparisons of field performance data showed that more work per unit time was accomplished on flat land as compared with sloping land. Farming a parallel terrace system required 5 to 34 percent less time than farming a conventional system of terraces.

Terrace interval size and configuration influenced field performance by changing the average row length. An expression was developed which showed the percent of the total time spent turning as an exponential function of the average row length.

The reduction in plant population was found to be confounded with operators. Each operator reacted differently to the obstacles of land slope and row curvature encountered during cultivation.

U. Ill., Urbana, Ill. 61803

151. Mickelson, R. H., Cox, M. B., and Musick, J. RUNOFF WATER-SPREADING ON LEVELED CROPLAND. J. Soil and Water Conserv. 20(2): 57-60. 1965.

A runoff water-spreading system involving land-forming to conserve moisture for annual crop production was developed at the Central Great Plains Field Station near Akron, Colo. The system consists of level pans constructed in broad natural drainageways to intercept, spread, and retain runoff normally flowing through the waterways. In 1962, the spreader system provided 4 to 7 inches of additional available water on the leveled areas and this additional moisture effected substantial increases in crop yields. Due to the additional available amounts and uniform distribution of water, water-use efficiencies of crops on the leveled areas were double those of crops on unleveled check strips. The gross return from increased crop yields may pay for construction of level pans within a period of 3 to 5 years.

SWCRD, ARS, USDA, Akron, Colo. 80720

Critical Areas

See Also 163, 339.

152. Garber, L. W. RELATIONSHIP OF SOILS TO EARTHFLAWS IN THE PALOUSE. J. Soil and Water Conserv. 20(3): 21-23. 1965.

One striking form of soil erosion in the Palouse region of the Pacific Northwest is the earthflows that occur during the spring of the year. Several hundred tons of soil may move downslope in large earthflows.

The properties of soils on which earthflows are likely to occur were described and these properties were related to physical forces operative in the soils. Management techniques that can be used to prevent earthflows were discussed.

SCS, USDA, Moscow, Idaho 83843

153. Schessler, T. E., and Droege, R. F. STRIP-MINE RECLAMATION: A DIGEST. J. Soil and Water Conserv. 20(3): 17-20. 1965.

The Mined Area Restoration Committee of the Soil Conservation Society of America has completely revised the publication "A Digest--Strip-Mine Reclamation," which was originally issued in 1962 by the eastern regional office of the U.S. Forest Service. The revised work reflects the extensive changes recently made by a number of States in their laws pertaining to strip mining. Also included in the publication were discussions of strip-mine spoil characteristics, revegetation of mined areas, and potential uses of strip-mined lands. This article was a review of the highlights of the "Digest".

Bur. Land Mngt., U.S. Dept. Int., Battle Mountain, Nev. 89820

154. Lorio, P. L., Jr., Gatherum, G. E., and Shrader, W. D. TREE SURVIVAL AND GROWTH ON IOWA COAL-SPOIL MATERIALS. Iowa Agr. Expt. Sta. Sp. Rpt. 39, 12 pp. 1964.

An evaluation was made of 7- to 8-year survival and growth of 15 tree species of conifers and hardwoods planted on several classes of coal-spoil materials in southeastern Iowa. The more important results were:

1. Green ash survived better than all other species on a variety of coal-spoil materials and appeared best adapted to the more moist sites on the moderately acid to calcareous spoils.
2. Cottonwood grew much faster than all other species on a variety of coal-spoil materials and grew to more than double the height of green ash.
3. Survival and growth of eastern redcedar were best on the calcareous coal-spoil materials. This species is drought, resistant and can be planted on the drier sites.

4. Survival and growth of all pine species tested were very poor on the calcareous coal-spoil materials.
5. Of all species tested, jack and Virginia pine appeared best adapted to the dry sites on the strongly and moderately acid spoil materials. Pitch pine was adapted to the same materials but probably should be planted on more moist sites.
6. Red and eastern white pine were best adapted to the slightly acid, more fertile, moist, well-drained sites.

Agr. & Home Econ. Expt. Sta., Iowa State U. Sci. and Tech., Ames, Iowa 50010

SOIL MANAGEMENT

Cropping Practices

See Also 52, 175, 177, 229, 238, 243, 266-268, 272, 279, 280, 287, 351-353.

155. Malik, M. N., Stevenson, D. S., and Russell, G. C. WATER-STABLE AGGREGATION IN RELATION TO VARIOUS CROPPING ROTATIONS AND SOIL CONSTITUENTS. Canad. J. Soil Sci. 45(2): 189-197. June 1965.

The effects of four cropping systems on water-stable aggregation were compared. The following two methods of wetting the soil were also compared: (1) Capillarity; (2) under vacuum prior to wet-sieving. Various soil constituents were determined to assess their roles in the promotion of granulation and stability. Water-stable aggregation in grassland was significantly higher than in the other three long-term rotations, corn once in 9 years, continuous wheat, and 4 years alfalfa in 10 years. No significant differences in water-stable aggregation were found among the other three rotations.

Wetting the soil by capillarity was judged to give a better index of soil aggregate stability than wetting under vacuum. Organic carbon and stable aggregation were positively correlated in the grassland soil and in the soil of the cultural treatments combined over all depths, suggesting an important role of organic matter in stabilization of soil aggregates. In cultivated soils, the cultivation or the type of root system of the crops may override the influence of the organic carbon. Total soluble salts were positively correlated with aggregation in a few treatments.

Res. Sta., Canada Dept. Agr., Lethbridge, Alberta, Canada.

Soil Conserv. 30(5): 99-119. Dec. 1964.

This issue of the Soil Conservation Magazine was devoted to articles on conservation practices. The following articles were given:

156. Larson, E. J. NEW SOIL CLASSIFICATION: WHAT WILL IT MEAN TO THE SOIL SURVEY USER WHEN THE REVISED SYSTEM GOES INTO EFFECT? SCS, USDA, Washington, D. C. 20250
157. Keyes, W. J. MINIMUM TILLAGE: FOR CORN AND SOYBEANS. SCS, USDA, Sparta, Ill. 62286
158. Hayes, W. A., and Roy, C. MINIMUM TILLAGE: FOR POTATOES. SCS, USDA Upper Darby, Pa.
159. Young, W. C., and Leithead, H. L. NEW GRASSES FOR THE SOUTHEAST: SCS PLANT MATERIALS CENTERS TURN TO NATIVES TO FIND ADAPTED RANGE FORAGE SPECIES. SCS, USDA, Ft. Worth, Tex.
160. Turelle, J. W. WIND EROSION CONTROL GUIDES: CURVES ADAPT BASIC RESEARCH TO SHOW SOIL LOSS RATES FOR GREAT PLAINS CROPLAND. SCS, USDA, Portland, Oreg.
161. Shrader, W. D., and Riecken, F. F. SOIL SURVEY USE IN IOWA: CROP YIELD DATA HELP FARMERS, TAX ASSESSORS BENEFIT FROM MAPS COVERING ALL COUNTIES. Iowa State U., Ames, Iowa. 50010

162. Eagles, L. D., and Kirkpatrick, O. S. ROADSIDE BEAUTY AND SAFETY: DRIVERS REAP BENEFITS OF EROSION CONTROL PROGRAM ON SOUTH CAROLINA HIGHWAYS. SCS, USDA, Florence, S.C. 29501
163. Long, L. H. MECHANICAL SODDING METHOD SOLVES WATERWAY PROBLEM. SCS, USDA, Presque Isle, Maine 04769
164. Anonymous. SINKHOLE PONDS PROVIDE WATER IN LIMESTONE AREA.
165. Billings, W. H., and Rountree, B. H. NURSERY ALTERNATES TREES AND CATTLE IN SAME FIELDS. SCS, USDA, Elsberry, Mo. 63343
166. Moore, C. L. MONTEREY PINES MAKE GOOD CHRISTMAS TREES. SCS, USDA, Santa Maria, Calif. 93454
167. Williams, D. A. GREAT SOCIETY: TECHNICAL GUIDES: KEEPING UP. SCS, USDA, Washington, D. C. 20250
168. Weaver, M. L., and Nylund, R. E. THE SUSCEPTIBILITY OF ANNUAL WEEDS AND CANADA THISTLE TO MCPA APPLIED AT DIFFERENT TIMES OF DAY. Weeds 13(2): 110-113. Apr. 1965.

Lambsquarters (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.), and white mustard (Brassica hirta L.) were highly susceptible to MCPA regardless of the pretreatment light exposure to which they were subjected. These broadleaved weeds were slightly more susceptible to MCPA applied after a prolonged period of darkness. Neither total carbohydrate, reducing sugar, protein, nor amino acid contents at the time of spraying were associated with the susceptibility of mustard plants to MCPA. Floral bud development on Canada thistle was greatly reduced by MCPA applied at any time of the day to plants 9 and 12 inches tall and was prevented on plants 3 and 6 inches tall. The susceptibility of broadleaved annual weeds and Canada thistle to MCPA was not affected by variations in temperature and humidity at time of spraying.

Wash. State U., Pullman, Wash. 99163

169. Evans, R. A., and Eckert, R. E., Jr. PARAQUAT-SURFACTANT COMBINATIONS FOR CONTROL OF DOWNY BROME. Weeds 13(2): 150-151. Apr. 1965.

Downy brome (Bromus tectorum L.) control by paraquat was increased from 12 percent without surfactant to 73 to 94 percent with 17 of 22 surfactants. Paraquat toxicity was greatest at 0.06 and 0.12 percent surfactant concentrations and decreased at higher concentrations. The less effective surfactants were less water soluble and more lipophilic than related, more effective ones.

CRD, ARS, USDA, U. Nevada, Reno, Nev. 89507

170. Singh, R. K. N., and Campbell, R. W. HERBICIDES ON BLUEGRASS. Weeds 13(2): 170-171. Apr. 1965.

Listed on the basis of visual ratings in September 1961, in the order of increasing toxicity to Kentucky bluegrass sown in April 1961 and treated May 31 and June 6, the herbicides were DCPA, diphenatril, DMA, dipropalin, calcium arsenate, DMPA, and trifluralin. All herbicides except DCPA and DMPA (liquid) persisted after 2 years of use until March 1963 in the top 2 inches of soil.

Kans. Agr. Expt. Sta., Kans. State U., Manhattan, Kans. 66504

171. Bingham, S. W., and Schmidt, R. E. BROADLEAVED WEED CONTROL IN TURF. Agron. J. 57(3): 258-260. 1965.

For several years 2,4-D has been a common standard for evaluating new herbicides for many broadleaf weeds. A series of studies was conducted to evaluate a new herbicide and less volatile forms of phenoxy herbicides.

The substituted oleyl amine salts of 2,4-D, 2,4,5-T, and silvex were equally effective for control of white clover, buckhorn plantain, curly dock, and chicory as the dimethylamine salts of these herbicides.

Dicamba gave effective control of white clover, chicory, chickweed, dandelion, and curly dock. Buckhorn plantain was not controlled completely with any of the herbicide treatments; however, phenoxy herbicides gave the best control. Silvex gave effective control of purslane speedwell.

Dicamba at 1/2 pound per acre was effective for control of white clover, with little or no phytotoxic effect of bentgrass turf.

When dicamba was used preemergence to five grass species, seedling establishment was delayed and, in general, the number reduced.

Va. Polytech. Inst. Blacksburg, Va. 23501

Crop Residue Management

See Also 52, 106, 155, 200, 212.

172. Smith, J. H., and Burns, G. R. ION GRADIENTS AND NITRIFICATION ASSOCIATED WITH DECOMPOSITION OF A PLANT MATERIAL LAYER IN SOIL. Soil Sci. Soc. Amer. Proc. 29(2): 179-181. 1965.

Changes in the pH and in concentrations of ammonia, NO_2^- , NO_3^- , and K^+ with distance from layers of decomposing leguminous plant material in Red Bay sandy loam soil were measured after 16 days' incubation. High concentrations of ammonia (2.7 meq. g.) and of K^+ (1.4 meq. g.) were found near the plant material layer. Nitrification was inhibited and NO_2^- was found in this zone. Farther away, NO_3^- accumulated. A change in pH from 8.9, near the layer, to 5.6 about 4 cm. away, was observed.

Treatment with CaCO_3 decreased the pH range and increased nitrification. When the decomposing plant material layer was separated from the soil on one side by an air space, NH_2 diffused across the air space. This resulted in segregation of some of the NH_3 from the cations and other potentially toxic substances and lowered the overall toxicity to nitrification. Besides the toxicity observed, the availability of plant nutrients, as well as growth of microorganisms and plant roots, could be drastically affected by pH and cation concentration changes found near layers of decomposing plant material.

SWCRD, ARS, USDA, Kimberly (Twin Falls), Idaho 83341.

Tillage

See Also 157, 158, 212, 241, 266, 280.

173. Brill, G. D., Alderfer, R. B., and Hanna, W. J. EFFECTS OF SUBSOILING AND DEEP PLACEMENT OF FERTILIZER ON A COASTAL PLAIN SOIL AND VEGETABLES. Agron. J. 57(2): 201-204. 1965.

A field study to determine the effect of subsoiling and deep placement of lime and fertilizer on a coastal plain soil and on vegetables grown in the soil, was conducted from 1956-63. The soil was a Collington sandy loam with a dense layer below plow depth formed by continuous row cropping. Subsoiling 18 inches deep at 18-inch intervals with and without deep placement of lime phosphorus, and potassium was done in the fall of 1956 and again in the fall of 1959. A high-fertility level was maintained in the surface soil throughout the experiment.

Though plant roots tended to concentrate in the deeply fertilized areas, no definite evidence of root impedance was found in nontilled plots. There were indications that potassium moved upward from the deeply fertilized area into the surface soil over the period of the experiment. Measurements of bulk density, porosity, and infiltration showed that subsoiling improved the soil physical condition below plow depth. In this sandy soil, runoff was still significantly reduced 3 years

after subsoiling. Subsoiling and deep placement of lime and fertilizer had no significant effect on the yields of cabbage, sweet corn, and tomatoes over the 7-year period, even in very dry years.

SWCRD, ARS, USDA, New Brunswick, N.J. 08903

174. Woodruff, N. P., Fenster, C. R., Chepil, W. S., and Siddoway, F. H.
PERFORMANCE OF TILLAGE IMPLEMENTS IN A STUBBLE MULCH SYSTEM. II. EFFECTS ON
SOIL CLODDINESS. Agron. J. 57(1): 49-51. 1965.

Results of a 3-year field study of soil cloddiness from tillage with 6 different implements commonly used in stubble mulch farming were presented.

Results varied from year to year, but the average data for implements used initially on undisturbed wheat stubble indicated that the cultivator with chisels 2 inches wide and the 32-inch sweep implement produced the highest degree of cloddiness at the soil surface, followed in order by the one-way disk operated 4 inches deep, the rodweeder with shovels, the 8-foot V-sweep, and the one-way operated 2 inches deep.

Data obtained after second and subsequent tillage varied widely, probably because of soil moisture variation at tillage. Generally the cloddiest surface was obtained with 32-inch sweeps on land previously tilled with the 8-foot V-sweep, the 2-inch chisels, or the rodweeder with shovels, and the one-way or the 8-foot V-sweep on land previously tilled with the 8-foot V-sweep.

Mechanical stability of clods varied more or less directly with the percentage of clods.

SWCRD, ARS, USDA, Manhattan, Kans. 66504

175. Fenster, C. R., Woodruff, N. P., Chepil, W. S., and Siddoway, F. H.
PERFORMANCE OF TILLAGE IMPLEMENTS IN A STUBBLE MULCH SYSTEM: III. EFFECTS
OF TILLAGE SEQUENCES ON RESIDUES, SOIL CLODDINESS, WEED CONTROL, AND WHEAT
YIELD. Agron. J. 57(1): 52-55. 1965.

Substantial differences in average amounts of residue conserved at the end of the tillage season were found among many of the tillage sequences tested. Generally, more wheat-stubble residue was conserved with tillage sequences by using subsurface implements exclusively than by using one-way disks in combination with other implements. The effect of any given combination of implements was strongly related to amount, and slightly to height, of stubble. One combination of implements may be more effective for a given height and amount of stubble than for another combination. The variation in measurement of implement performance in the conservation of residues was also recognized.

Surface soil cloddiness at the end of a tillage season was extremely variable. Differences among tillage sequence were not statistically significant. Repeated tillage tended to remove much of the difference in cloddiness produced by initial tillage.

Significant differences in degree of weed control were obtained after the completion of the first two of four tillage operation sequences. Sequences employing one-way disks exclusively or in combination with other implements provided significantly better general weed control and specific downy brome control than did sequences using subsurface tillage machines exclusively.

Effects of tillage sequence on wheat yields were variable. Significantly higher yields in 1960-61 were obtained for sequences using one-way disks in combination with other implements than for sequences using subsurface implements exclusively. For the 1961-62 season, which was moderately wet, substantially higher yields were again found for one-way sequences. These differences were not statistically significant. A highly significant correlation between yield and weed control during the tillage season was found for the dry 1960-61 season.

Box Butte Expt. Sta., Alliance, Nebr. 69301

176. Carter, L. M., Stockton, J. R., Tavernetti, J. R., and Colwick, R. F. PRECISION TILLAGE FOR COTTON PRODUCTION. Trans. ASAE 8(2): 177-179. 1965.

Precision tillage, subsoiling under the intended drill row and bedding in the same operation, was demonstrated to be an effective method of increasing cotton yields in certain soils where root extension was inhibited by soil compacting. The channel of low impedance soil under the cotton plant resulting from precision tillage promoted deep and straight taproots. Yield increases averaging 30 percent were obtained from precision tilling to depths of 18 to 22 in. in fields of coarse-textured soils with less than 12 percent field capacity moisture. No significant increases were measured in soils with field-capacity moisture values greater than 15 percent. Shallow precision tillage was ineffective in promoting a deep-rooting system and in increasing yields. Precision tillage was as effective in increasing cotton yields when applied in wet soils as in dry soils.

ARS, USDA, Shafter, Calif. 93263

177. French, G. W., and Blake, G. R. PRIMARY TILLAGE FOR POTATOES. Trans. ASAE 8(2): 246-248. 1965.

The effect of primary tillage for potatoes were studied on Bearden silty clay loam at Grand Forks, N. Dak. The 3 years of omitting primary preplant tillage for potatoes following wheat the previous year, gave yields as high as any of four other treatments. Early emergence rates seemed to be adversely affected by the no-tillage treatment, but final emergence was not affected. There was some indication that deep tillage or plowing in the spring resulted in more clods at harvesttime. Potato digger draft was not markedly affected by primary tillage treatment.

Plowing in fall or spring was detrimental to yield as compared to no tillage, except that fall plowing gave good results in a year of high May rainfall. Although there was a trend toward lower yields with deep tillage than with no tillage, differences among these three treatments were not statistically significant.

In 1961 and 1962, planting of all five of the primary-tillage treatments was accomplished with no unusual difficulty. In 1963, considerable difficulty was experienced in planting plots which had not been plowed. The amount of straw was much greater than in the 2 preceding years and straw frequently clogged the furrow-opener disks. Some difficulty was caused by straw during the first cultivation. Later, cultivations were carried out without interference by the straw on any of the treatments.

Weeds were controlled entirely by mechanical means. Early weed growth was much greater on the unplowed plots prior to planting of the potatoes. Weeds in the rows were eliminated by the furrow openers of the planter. Weeds remaining in the middles were subsequently eliminated by cultivation. After the second cultivation, there were no apparent differences among treatments in respect to weed control. Complete control was achieved each year by cultivations applied uniformly to all plots.

Red River Valley Res. Cent., AERD, ARS, USDA, Grand Forks, N. Dak. 58201

178. Fox, W. R., and Bockhop, C. W. CHARACTERISTICS OF A TEFLON-COVERED SIMPLE TILLAGE TOOL. Trans. ASAE 8(2): 227-229. 1965.

One way to reduce the total draft of a tillage implement is to reduce the force required to slide the soil over the soil-engaging surface. Teflon or Teflon-with-glass filler used as a surface cover was of value in reducing friction forces and improving scouring in soils of high-clay and of high-moisture content. By using Teflon or Teflon-with-glass filler, it was possible to reduce the draft by 6 to 38 percent, depending on clay content and moisture content of the soil. Teflon or Teflon-with-glass filler wore eight to ten times more rapidly than steel.

Miss. State U., State College, Miss. 39762

Fertility Requirements for Conservation Farming

See Also 22, 30, 32, 33, 35, 70, 93, 95-102, 104-106, 112, 115, 116, 118, 121-130, 133, 134, 173, 208, 211, 214, 227, 231, 239, 241, 242, 247, 251, 263, 264, 272, 277, 284, 333

179. Griffith, W. K., and Teel, M. R. EFFECT OF NITROGEN AND POTASSIUM FERTILIZATION, STUBBLE HEIGHT, AND CLIPPING FREQUENCY ON YIELD AND PERSISTENCE OF ORCHARDGRASS. *Agron. J.* 57(2): 147-149. 1965.

Orchardgrass fertilized factorially with three levels each of nitrogen and potassium was harvested every 4, 5-1/2, and 7 weeks in 1958. A differential cutting height leaving 2 versus 4 inches of stubble was introduced into each management system at the time of the second harvest. A spring harvest in 1959 was taken to determine the carryover effects from the previous year's management. Yields and persistence were used as criteria to evaluate the influence of fertility and management.

A multiple regression analysis revealed that nitrogen was a major factor influencing yields in 1958. While potassium effects were limited to the longer growing periods in 1958, the carryover effects in 1959 were highly significant for all growing periods.

Low clipping (2-inch stubble) caused stand reductions up to 57 percent at high nitrogen. Greatest losses occurred with low potassium.

Amer. Potash Inst., Washington, D.C. 20006

180. Rayment, A. F. THE RESPONSE OF NATIVE STANDS OF LOWBUSH BLUEBERRY IN NEWFOUNDLAND TO NITROGEN, PHOSPHORUS, AND POTASSIUM FERTILIZERS. *Canad. J. Plant Sci.*: 45(2): 145-152. Mar. 1965.

Native Newfoundland stands of lowbush blueberries (*Vaccinium angustifolium* Ait.) were fertilized with ammonium nitrate, superphosphate, and muriate of potash in various combinations. Nitrogen caused earlier fruit maturity, increased berry size, and generally reduced fruit numbers, especially when in combination with added phosphorus. When nitrogen was used alone at 50 lb./A., it gave an average yield increase of over 50 percent in the first pickings.

When phosphorus and potassium were used together in the absence of nitrogen, there was an increase in fruit numbers resulting in higher yield. Combination of phosphorus with nitrogen was accompanied by increased vegetative growth of the blueberry and associated plants and decreased yields.

Expt. Farm, Canada Dept. Agr., St. John's West, Newfoundland, Canada.

181. MacLeod, L. B., Bishop, R. F., Jackson, L. P., and MacEachern, C. R. EFFECT OF RATE AND TIME OF NITROGEN AND INTERVAL OF PHOSPHORUS AND POTASSIUM FERTILIZATION ON HERBAGE PRODUCTION ON PERMANENT PASTURE. *Canad. J. Soil Sci.* 45(2): 153-164. June 1965.

In two 3-year cycles of a field experiment, annual N treatments were superimposed on mineral treatments applied annually and triennially to a permanent pasture sward.

Applications of P and K were reflected by changes in exchangeable K and acid-soluble plus absorbed P. There was somewhat greater penetration of K than of P and soil levels of both were generally lowest where rate of N application was highest.

Yields varied from year to year but tended to be more uniform with annual than with triennial mineral treatments. In the 6-year period, average yields for all 0-, P-, K-, and P-K-treated plots were approximately 1.3, 1.6, 1.5, and 2.0 tons per acre, respectively, of dry matter. Time of nitrogen application had little influence on total yield but seasonal distribution of herbage was much more uniform with nitrogen applied in summer than in spring. Soil moisture, which was a major factor in the response obtained with nitrogen applied in summer, was limiting during the late summer in 2 of the 3 years measured.

Percentages of P and K in grass reflected the mineral treatments which had much less influence on botanical composition and species foliage cover than N. This

element suppressed legumes, increased grass, and markedly influenced the K level in grass.

Expt. Farm, Canada Dept. Agr., Nappan Nova Scotia, Canada.

182. Locke, L. F., Eck, H. V., and Tucker, B. B. GRAIN SORGHUM FERTILIZATION IN NORTHWESTERN OKLAHOMA. Okla. State U. Expt. Sta. B. 627, 14 pp. 1964.

Seven crops of wheatland grain sorghum were grown on a fertilizer experiment in which rates of nitrogen, phosphorus, and potassium were studied. Precipitation for the period was above average, and yields were above average for the soil type involved.

Yields were increased by the use of nitrogen combined with phosphorus and to a lesser extent by nitrogen alone. Phosphorus alone did not increase yields. Potassium combined with nitrogen and phosphorus did not increase yields above those from the same amounts of nitrogen and phosphorus without potassium. Applied nitrogen and phosphorus increased the respective nitrogen and phosphorus contents in leaf samples taken at bloom stage. Applied potassium did not affect potassium contents of the leaves.

In a moisture-use study, a fertilizer treatment consisting of 60 pounds of nitrogen and 60 pounds of P_2O_5 per acre per year increased yields an average of 193 percent during 4 consecutive years.

Okla. State U. Expt. Sta., Stillwater, Okla. 74075

183. Hallock, D. L., and Blaser, R. E. FERTILITY INVESTIGATIONS WITH A LADINO-ORCHARDGRASS MIXTURE IN SOUTHEASTERN VIRGINIA, 1954-1961. Va. Agr. Expt. Sta. Res. Rpt. 88, 28 pp. 1964.

Phosphorus, potassium, and nitrogen fertility investigations with a ladino-orchardgrass mixture were conducted on Bertie fine sandy loam at Holland, Va., from 1954-61. Fertilization rates for establishment of the seeding varied from 0 to 15 lb./A. of nitrogen, 0 to 400 lb./A. of phosphate (P_2O_5), and 0 to 100 lb./A. of potash (K_2O). Annual fertilization rates varied from 0 to 150 lb./A. of nitrogen, 0 to 100 lb./A. of phosphate, and 0 to 300 lb./A. potash. The principal results of this study were:

1. Average yields of approximately 4 tons/A. of forage, including weeds, were obtained from the highest rate of nitrogen (150 lb./A.).
2. Yields of first cutting hay were nearly double those of any other cutting; yields of third cutting hay were lowest.
3. The 150-lb. rate of nitrogen and to some extent the February 50-lb. rate markedly decreased the average percentage of ladino and increased the average percentage of orchardgrass in the clippings.
4. In August 1959, average stands of both ladino and orchardgrass were lowest under the 150-lb. rate of nitrogen and next lowest on plots not fertilized with phosphorus.
5. The percentage of protein in ladino and orchardgrass was not influenced appreciably by any of the fertilizer treatments.
6. The percent of phosphorus, calcium, or magnesium in ladino and orchardgrass did not vary appreciably among the different fertility treatments.
7. Available soil phosphorus (Truog) levels in 1959 were still nearly similar among the various fertility treatments. By 1959, exchangeable soil potassium contents to a depth of at least 24 inches were markedly lower in plots fertilized at a rate of 50 lb. or less of potash, annually.
8. Relatively few significant correlations were obtained between plant data and available soil phosphorus data. Soil potassium contents were quite closely correlated with that in both ladino and orchardgrass.

Tables.

Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va. 24061

184. Gingrich, J. R. EFFECT OF SOIL TEMPERATURE ON THE RESPONSE OF WINTER WHEAT TO PHOSPHORUS FERTILIZATION. Agron. J. 57(1): 41-44. 1965.

Winter wheat was grown in the greenhouse at soil temperatures of 50°, 65°, and 80° F. on Norge silt loam.

Yield of dry matter 24 days after planting was not affected significantly by applications of phosphorus when the soil was maintained at 50° regardless of the phosphorus level present in the soil. Apparently the rate of absorption and translocation at this soil temperature was so low that even the low phosphorus soil had sufficient available phosphorus. When soil temperatures were maintained at 65° and 80°, the amount of dry matter produced on the low phosphorus soil was doubled by the addition of 8.8 p.p.m. of P. An additional 8.8 p.p.m. had no significant effect on the amount of dry matter.

In general, for a high phosphorus soil, the amount of dry matter produced 24 days after planting was affected slightly by the addition of 8.8 p.p.m. of P at soil temperatures of 65° and 80°. However, an additional 8.8 p.p.m. tended to give a slight decrease in yield.

The percentage of phosphorus in the tops was affected greatly by the phosphorus applied, regardless of the level of available phosphorus in the soil, but in general was not affected by soil temperature.

In general, even on a soil low in available phosphorus, early growth of winter wheat may not be increased greatly by phosphorus fertilization when soil temperatures are too low. Even though the percentage of phosphorus in the tops was not affected by soil temperature, the total amount of phosphorus absorbed and metabolized was affected by temperature in the same general relationship that yields of dry matter were affected by soil temperature.

Okla. State U. Expt. Sta., Stillwater, Okla. 74075

185. Stanberry, C. O., and Lowrey, M. BARLEY PRODUCTION UNDER VARIOUS NITROGEN AND MOISTURE LEVELS. Agron. J. 57(1): 31-34. 1965.

Barley yields may be affected by altering one or more yield components (plants per unit area, heads per plant, seeds per head, and individual size or weight per seed). In this study, barley yields were increased dominantly by increasing heads per plant (tillering) and seeds per head. Supplemental N rate increased yields much more than other variables (N source, barley variety, or irrigation treatment). Appreciable supplemental N increased yields about 600 percent, whereas the "wet" moisture treatment exceeded the "dry" treatment by no more than 36 percent. However, when these two treatments were combined the increase exceeded 1700 percent.

Moisture utilization efficiency (M.U.E.) was highest for the "dry" moisture regime. However, this resulted in reduced grain yields. Except for limited water applications, however, cultural treatments increasing barley yields increased M.U.E. proportionally. Barley producing less than 500 lb./A. required almost as much moisture for evapotranspiration as that producing 4,000 pounds per acre.

SWCRD, ARS, USDA, Tucson, Ariz. 85705

186. Kay, B. L., and Evans, R. A. EFFECTS OF FERTILIZATION ON A MIXED STAND OF CHEATGRASS AND INTERMEDIATE WHEATGRASS. J. Range Mangt. 18(1): 7-11. 1965.

A 4-year fertilizer study was established on a 1-year old stand of intermediate wheatgrass infested with cheatgrass. Two field trials were included, one open to grazing and the other protected. Nitrogen was applied at three rates, with and without sulfur. Initial application of nitrogen was compared with annual reapplication. Plots were sampled for yield and botanical composition by ground cover.

Results indicated that applied nitrogen, especially at the higher rates, favored cheatgrass at the expense of the wheatgrass under the dry conditions of this study. Grazing increased the detrimental effects of high-nitrogen fertilization on intermediate wheatgrass. Rapid depletion of soil-moisture, the result of increased growth of cheatgrass under high nitrogen in a period of below-normal precipitation, was postulated to be the principal cause of reduction of intermediate wheatgrass.

Increases in forage yield occurred only in the better forage years. In no instance, did the forage response justify the cost of the fertilizer.

U. Calif., Davis, Calif. 95616

187. Lutwick, L. E., Smith, A. D., and Johnston, A. FERTILIZER EXPERIMENTS ON NATIVE RANGELANDS USING INCREASING-RATE SPREADER. J. Range Mangt. 18(3): 136-139. 1965.

Nitrogen fertilizer was applied at increasing rates from 0 to over 800 lb. N per acre to strips of native rangeland vegetation. Sub-plots for yield measurement were chosen at intervals along the strips. Because of variability of stand of herbage on native rangelands and the consequent difficulty of finding relatively large uniform areas, the increasing-rate fertilizer spreader offers a method of overcoming these difficulties in fertilizer rate studies on these rangelands.

Canada Dept. Agr. Res. Sta., Lethbridge, Alberta, Canada.

188. Rihm, E. LONG-TERM EXPERIMENTS WITH CHILEAN NITRATE OF SODA. World Crops 17(1): 56-63. 1965.

Since inorganic fertilizers were first introduced, much information has been obtained from long-term experiments laid down in different parts of the world with a view to studying the effects of the application of these fertilizers in different soil and climatic conditions over a long period of years on crop yields and on soil characteristics, such as reaction, structure, phosphate availability, base exchange, and contents of bases and other elements.

Chilean nitrate of soda has been tested in experiments lasting more than a century. With adequate drainage, calcium, and organic matter supply, it maintains the physical and chemical condition of the soil and gives continuous high yields. These results are due to the fact that nitrate of soda does not acidify the soil and that it maintains the equilibrium of bases.

The results of the principal long-term experiments carried out in a number of countries with various crops under different soil and climatic conditions with particular reference to Chilean nitrate of soda were presented.

Nitrate Corp., Chile Ltd., London, England.

189. Hutcheson, T. B., Jr., and Freeman, J. F. LONGEVITY OF SOIL REACTION EFFECTS FOLLOWING LIME AND ALUM ADDITIONS. Agron. J. 57(1): 89-90. 1965.

Effects of lime and aluminum sulfate on pH were quite pronounced 6 weeks after application, but had diminished in 12 months and changed little during an additional 24-month period. Three years, after applications, little effect was evident on pH, exchangeable acidity, Al, Ca, or Mg below 8 inches. Exchangeable Al levels were less than one-hundredth of those actually applied, indicating that hydrolysis and precipitation of Al as some species of aluminum hydroxide had occurred.

Va. Polytech. Inst., Blacksburg, Va. 24061

190. Smoliak, S. EFFECTS OF MANURE, STRAW AND INORGANIC FERTILIZERS ON NORTHERN GREAT PLAINS RANGES. J. Range Mangt. 18(1): 11-15. 1965.

Manure, straw, and straw-plus-fertilizer treatments increased forage production significantly up to 8 years after fertilization. Forage on plots treated with manure, fertilizer, and straw-plus-fertilizer generally contained higher amounts of crude protein, crude fiber and phosphorus, and lower amounts of nitrogen-free extract, ether extract, and calcium than forage on control plots. There was a differential species response to the additional nutrients and mulch supplied by the organic and inorganic treatments. Blue grama decreased while western wheatgrass increased in basal area on plots treated with manure and straw-plus-fertilizer. Basal area of little clubmoss was reduced substantially on the manure, straw, and straw-plus-fertilizer treatments.

Response from applications of straw was attributed to the mulch effect. Response from applications of barnyard manure was due to the nutrients and to the mulch supplied.

Fertilization can be employed as a range management technique to increase livestock production through increased forage yields, through the increased nutritional qualities of the forage, and through the induced changes in the botanical composition of the sward.

Canada Agr. Res. Sta., Lethbridge, Alberta, Canada.

191. Perkins, H. F., Parker, M. B., and Walker, M. L. CHICKEN MANURE--ITS PRODUCTION, COMPOSITION, AND USE AS A FERTILIZER. Ga. Agr. Expt. Sta. B. N.S. 123, 24 pp. 1964.

Recent investigations at several Georgia agricultural experiment stations indicated that broiler and hen manures were valuable sources of readily available plant nutrients.

The manures varied widely in composition as a result of type of bird, kind of feed consumed, climatic conditions, management of the poultry house, and system of handling the manure upon removal from the house. Broiler manure, as taken from the house, contained an average of 25.0 percent moisture, 1.7 percent N, 0.81 percent P, and 1.25 percent K. Hen manure averaged 39.9 percent moisture, 1.3 percent N, 1.20 percent P, and 1.14 percent K. Of the total P and K in the manures, about 90 percent were in available forms.

Accumulated floor litter from 1,000 broilers in 10 weeks averaged about 2.12 tons, containing 25 percent moisture.

Significant yield responses were obtained for all crops investigated following the use of manures at rates from 2.5 to 16 tons per acre.

The percentage clover in a grass-clover sod was reduced by manure and commercial N.

Significant residual effects of chicken manure on yields of corn, oats, cotton, and a grass-legume mixture were obtained.

Spring weed infestation was increased markedly following broiler manure applications to Coastal bermudagrass.

Broiler manure applications to soils at Athens resulted in a temporary increase in soil pH values, but did not significantly influence pH of soils at Blairsville.

Annual applications of broiler manure markedly increased available P and K in soils at Athens and Blairsville.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Athens, Ga. 30601

192. Jones, J. H., and Taylor, G. S. SEPTIC TANK EFFLUENT PERCOLATION THROUGH SANDS UNDER LABORATORY CONDITIONS. Soil Sci. 99(5): 301-309. 1965.

In a gravel-sand column in which septic tank effluent first percolated over the gravel, the zone of most rapid clogging was the region at the sand-gravel interface. The contraction of organic and inorganic deposits resulting from effluent applications was also highest in the interfacial region. The gravel accumulated up to 20 percent of the total deposits resulting from effluent loading, and it probably developed a higher percentage of organic decomposition because of its better aeration status.

Soil clogging under effluent loading occurred 3 to 10 times faster under an anaerobic environment than under an aerobic one, and sands of high initial hydraulic conductivities were clogged at a much slower rate than ones of low initial conductivity. Under aerobic conditions, there were the following three distinct phases of clogging in sand: (1) A period in which the conductivity declined to near 25 percent of its initial value; (2) a period where the conductivity fluctuates near the latter value for many months and declined slowly to near 10 percent of the original conductivity; and (3) a period where the conductivity dropped sharply to 1 or 2 percent of its initial value. Under anaerobic conditions, the second phase of clogging was absent, and the first and third phases were indistinguishable.

Ohio Agr. Expt. Sta., Wooster, Ohio 43210

193. Taylor, A. W., and Gurney, E. L. PRECIPITATION OF PHOSPHATE BY IRON OXIDE AND ALUMINUM HYDROXIDE FROM SOLUTIONS CONTAINING CALCIUM AND POTASSIUM. Soil Sci. Soc. Amer. Proc. 29(1): 18-22. 1965.

When acidic calcium phosphate solutions such as those formed by the dissolution of fertilizers react with aluminum hydroxide in the presence of little potassium, all the potassium is precipitated as taranakite, $K_3Al_5H_6(PO_4)_8 \cdot 18H_2O$; most of the rest of the phosphate is precipitated as aluminum and calcium aluminum phosphates. In the presence of considerable potassium, the precipitation of phosphate is governed by the initial composition of the solution; as much as 25 percent of the phosphate is precipitated as dicalcium phosphate and most of the rest is precipitated as taranakite. Iron oxide reacts much more slowly with phosphate than aluminum hydroxide and has much less effect on the precipitation of phosphate.

TVA, Wilson Dam, Ala. 35661

Salinity and Alkali Problems

See Also 39, 43, 71, 73, 79, 119, 130, 212.

194. Mulkey, J. R., Jr., and Bloodworth, M. E. SALT DISTRIBUTION IN A REAGAN SILT LOAM AFTER FIVE YEARS OF CONTINUOUS IRRIGATION. Tex. Agr. Expt. Sta. Misc. P. 749, 7 pp. 1964.

The results of a laboratory experiment to investigate the extent of salt accumulation in a Reagan sandy loam soil after 5 years of irrigation with saline water were given.

Three sampling dates were used. In June 1958, samples were taken before this location was cultivated. Pre-irrigation and post-irrigation samples were taken in April and May 1963, respectively.

The data showed a continuous buildup of soluble salts in the Reagan soil with prolonged application of saline water. The osmotic pressure in the 0-18 inch zone increased 6.35 atmospheres after 5 years of irrigation, or an average of 1.27 atmospheres per year.

A 6-inch border application of irrigation water caused a 4.28 atmosphere increase in the osmotic pressure of the 0-24-inch zone, while a 12-inch application of water by the border method caused a 3.96 atmosphere decrease at comparable depths.

Little change in osmotic pressure in the 0-24 inch zone was experienced with either a 6- or 12-inch furrow irrigation from samples taken from the center of the beds.

Tables.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843

195. Carter, D. L., and Wiegand, C. L. INTERSPERSED SALT-AFFECTED AND UNAFFECTED DRYLAND SOILS OF THE LOWER RIO GRANDE VALLEY: I. CHEMICAL, PHYSICAL, AND MINERALOGICAL CHARACTERISTICS. Soil Sci. 99(4): 256-260. 1965.

Nonirrigated soils of the Lower Rio Grande Valley of Texas were sampled by depth increments according to three salinity categories: (1) Bare saline; (2) transition, where crop growth was stunted by salinity; and (3) unaffected by salinity. All samples were analyzed for total salinity, constituent water-soluble ions, exchangeable ion status, particle-size distribution, CEC, and mineral type.

The accumulated soluble salts were mainly the Cl^- salts of Na^+ , Ca^{+2} , and Mg^{+2} . The water-soluble Na^+ concentration in the saline soils was not excessive. The ESP was high enough to classify the saline soils as saline-sodic soils, but no serious sodium problem was expected from leaching because of high Ca^{+2} and Mg^{+2} levels.

Differences in clay content, CEC, and surface elevation were the main distinguishing measured features likely to influence the salinity status of the study soils. Mineral types were essentially the same, and CEC and clay content followed the same general pattern with depth in the soil. The primary factor responsible for soil salinity appeared to be clay content. Clay content increased

sharply with depth in saline soils, whereas only slight increases with depth occurred in unaffected soils. Transition soils exhibited clay contents between the other two. Differences in soluble-salt accumulation in soils studied seemed to reflect the influence of clay content upon both the infiltration of rainwater and upward flow of water from the saline, regional, shallow water table.

Jr. Author, SWCRD, ARS, USDA, Weslaco, Tex. 78596

196. Bernstein, L. EFFECTS OF SALINITY ON MINERAL COMPOSITION AND GROWTH OF PLANTS. 4th Internat'l. Colloquium Plant Anal. and Fert. Prob. Proc. Brussels. pp. 25-45. 1964.

In a study of the effects of salinity on mineral composition and the growth of plants, the author concluded that:

1. In addition to the osmotic effect of salinity, nutritional factors may further depress growth. High CaCl_2 concentrations in the medium greatly increased Ca content and depressed K and Mg in bean plants; KCl similarly increased K content and depressed Ca and Mg. Mixed-salt solutions (Ca-K or Ca-Na) corrected the imbalance sufficiently to allow for full yields under the given osmotic conditions.
2. Growth of corn plants was better when CaCl_2 contributed to salinity than with any combination of NaCl, MgCl_2 , or KCl at comparable osmotic pressures.
3. The likelihood of unbalanced nutrition was greatly lessened by the mixed-salt solutions normally prevalent in saline soils.
4. Chloride and Na were specifically toxic to many fruit crops and ornamental shrubs and trees. Diagnostic tissue analysis was most useful in case of such toxicity. In other crop plants, diagnostic plant analysis was of limited utility except in assessing the possibility of nutrient imbalance or deficiency.
5. Interactive effects between ions may modify ionic uptake, producing such disturbances as sulfate-induced Ca-deficiency in some lettuce varieties and Ca-enhanced chloride uptake in stone-fruit crops.
6. The proportions of specific nutrients required for adequate nutrition may be different under high-salt and low-salt conditions, as well as under sodic (high exchangeable Na percentages) and non-sodic conditions.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif. 92502

197. Rasmussen, W. W., Lewis, G. C., and Fosberg, M. A. IMPROVEMENT OF THE CHILCOTT-SEBREE (SOLODIZED-SOLONETZ) SLICK SPOT SOILS IN SOUTHWESTERN IDAHO. U.S. Dept. Agr., Agr. Res. Serv., ARS 41-91, 39 pp. 1964.

Large areas of irrigated farmland in southwestern Idaho and southeastern Oregon contain scattered small areas of nonproductive, salt-affected soil. The peculiar spots are areas of naturally occurring solonetzic soil, containing excessive amounts of absorbed sodium and soluble salts. Because of the clayey nature of the tilled soils and the persistent wetness and slick condition of the affected soils following rains or irrigations, the soil areas are commonly referred to as "slick spots." In the irrigated croplands, the slick spots appear as areas of very sparse and stunted plant growth in otherwise productive lands. The poor plant growth is attributed to the unfavorable physical condition and extremely low rate of water infiltration during irrigations.

Slick spot soils occur over a wide area, affecting several thousands of acres of irrigated land in the Boise Valley in Idaho and adjacent areas in Oregon.

The soil improvement investigations reported were conducted on the Chilcott-Sebree (Solodized-Solonetz) slick spot soil complex.

The Chilcott-Sebree soils are typical of the slick-spot affected soils in the general area. The Sebree slick spot soil, classified as a Solodized-Solonetz, is described chemically as a saline-sodic (alkali) soil.

The Chilcott-Sebree soils occur most extensively on the uplands and higher terraces of the irrigated valleys. Certain croplands may contain from 25 percent to more than 50 percent of the unproductive Sebree slick spot soil. The slick spots are resistant to normal soil improvement procedures, and the presence of the spots is considered to be the most serious management problem in the area.

The results of several soil improvement investigations, conducted over a 7-year period, to determine practical means of improving and reclaiming the slick spot soils were reported.

SWCRD, ARS, USDA, Room 131, Adm. Bldg., PIS, Beltsville, Md. 20705

198. Carter, D. L., Wiegand, C. L., and Allen, R. R. THE SALINITY OF NONIRRIGATED SOILS IN THE LOWER RIO GRANDE VALLEY OF TEXAS. U.S. Dept. Agr., Agr. Res. Serv., ARS 41-98, 35 pp. 1964.

Results of two separate but similar studies were combined to present basic chemical, physical, and mineralogical properties of soils of the nonirrigated area in the Lower Rio Grande Valley of Texas in locations classified saline, transitional, and nonsaline on the basis of plant growth. From this study, the author concluded that:

1. Plant growth was a good criterion of the salinity status of the nonirrigated soils of southern Texas.
2. In saline soils the EC_e decreased sharply with increasing depth to 2 feet, below which the EC_e was nearly constant at about 17.0 mmhos/cm. Generally, the EC_e increased with increasing depth in both nonsaline and transitional soils. All transitional soils were saline below the 2-foot depth. Some of the nonsaline soils were saline below the 3-foot depth.
3. The principal salts in soils with EC_e levels greater than 2.0 mmhos/cm. were chlorides of Na^+ , Ca^{++} , and Mg^{++} ; bicarbonates of the same cations were the principal salts in soils with lower EC_e levels. Ca^{++} plus Mg^{++} composed over 50 percent of the water-soluble cations at depths shallower than 18 inches in saline soils, but Na^+ predominated below 18 inches from the surface in saline soils.
4. The ESP exceeded 15 percent in all saline soils and in some transitional soils. Therefore, many soils were saline-sodic.
5. Clay content increased sharply with depth in saline soils, becoming approximately 10 percent higher than in nonsaline soils below the 1-foot depth.
6. Layer-silicate mineral types did not differ among the soils studied. Montmorillonites, micas, and kaolinites were present in all soils, and vermiculite was present in small amounts in the surface 6 inches of some soils.

Tables.

SWCRD, ARS, USDA, Room 131, Adm. Bldg., PIS, Beltsville, Md. 20705

199. Padhi, U. C., Odell, R. T., Fehrenbacher, J. B., and Seif, R. D. EFFECT OF GYPSUM AND STARCH ON WATER MOVEMENT AND SODIUM REMOVAL FROM SOLONETZIC SOILS IN ILLINOIS. Soil Sci. Soc. Amer. Proc. 29(2): 227-229. 1965.

The improvement of solonetzic soils depends upon the replacement of excess exchangeable sodium and its removal by drainage. Gypsum and starch, both singly and in various combinations, were tested to determine their effect on water movement through and sodium removal from a solonetzic soil in Illinois. Significant amount of leachate were collected and sodium was removed from columns of disturbed B_2 horizon from a solonetzic soil treated with 8 tons/A. of gypsum and a combination of 8 tons of gypsum and 5 tons of starch/A. There was less leachate and sodium removed by other treatments.

Leaching and sodium removal were considerably reduced when the application rate of starch was raised to 10 tons/A., in combination with gypsum. This may be due to the low solubility of gypsum and the linkage between calcium and starch. Leachate and sodium removed were less from undisturbed cores 24 inches and 6 inches long than from columns of disturbed soil equivalent to the 6-inch cores.

Results were more variable from undisturbed soil cores than from disturbed soil columns. Results indicated that soil disturbance plus appropriate treatment,

especially with gypsum, increased water percolation and sodium removal from these solonetzic soils. Starch was not effective.

Agr. Chemist, Sambalpur, Orissa, India.

200. Ogata, G., and Bower, C. A. SIGNIFICANCE OF BIOLOGICAL SULFATE REDUCTION IN SOIL SALINITY. Soil Sci. Soc. Amer. Proc. 29(1): 23-25. 1965.

The effect of native and applied organic matter (straw) on sulfate reduction under anaerobic conditions in arid-zone soils was studied in the laboratory. Changes in the composition of dissolved and adsorbed ions as a consequence of SO_4 reduction were also studied.

The results indicated that SO_4 -reducing micro-organisms are generally present in arid-zone soils. Appreciable reduction of any SO_4 present does not occur when arid-zone soils become anaerobic by waterlogging unless undecomposed organic matter (plant residue) is present or the soil organic matter content is high (e.g., >5 percent). Sulfate reduction results in the formation of equivalent amounts of carbonates which, upon reaction with soluble or exchangeable Ca and precipitation as CaCO_3 , cause decreases in soil salinity and increases in the exchangeable sodium percentage.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif. 92502

Cover Crops and Green Manure Crops

201. Martin, D. E. SOIL SAVING IN SOUTHEAST MISSOURI. Land and Water Contract. 7(6): 17. 1965.

A report was given on the need and use of rye and vetch cover crops over winter and then leaving narrow strips of this to act as wind strip cropping to reduce wind erosion in the delta area of southeast Missouri.

In the delta area of Missouri, an estimated 140,000 acres are subject to severe wind erosion with another 225,000 acres subject to slight to moderate erosion. As more and more of the present fence rows are removed and the remaining forests cleared, the problem of wind erosion increases. Control measures should be applied to offset the removal of the protective barriers and prevent southeast Missouri from becoming the next dust bowl.

SCS, USDA, Charleston, Mo. 63834

Climatic Influences

See Also 7, 9, 31, 58, 62, 121, 133, 145, 146, 148, 149, 151, 184, 213-215, 224, 225, 230, 233, 240, 261, 270, 282, 283, 352.

202. Cromer, C. A., and Dickerson, W. H., Jr. SEASONAL VARIATION IN EXTREME RAINFALL OVER THE NORTHEASTERN UNITED STATES. Trans. ASAE 8(2): 180-182, 185. 1965.

Extreme rainfall for durations of 1 to 28 days was determined by a program developed for the IBM 1620 computer. Storm amounts which equalled or exceeded selected return period values were tabulated by months and seasons for eight weather stations in the Northeastern United States. The storms were classified as tropical or nontropical in nature.

Tropical storms were involved in a large percentage of the maximum rainfall events. For the stations examined, extreme rainfall for all of the durations was definitely a warm season phenomenon. Tropical storms provided some events in the fall as late as November; however, the months of June through October accounted for about two-thirds of all the storms.

Va. Polytech. Inst., Blacksburg, Va. 24061

Based on the laboratory study reported, it is reasonable to expect that raindrop impact forces on a soil surface will be increased when a thin water layer covers the surface. This may be explained by the raindrop's increasing its mass by some added virtual mass as it penetrates the shallow water layer. The resultant impact forces will then be greater than if the soil surface were bare.

The critical depth of water layer--the one causing maximum strain for a particular waterdrop--occurs in the region where the critical depth has a 1:1 relationship with the horizontal drop diameter on impact.

As indicated by the photographs of the depressions on the soil cans, the critical depth not only causes maximum strain, but appears to induce maximum splash from the impacting drops.

Water layers of 20 mm. were comparable to no water layer. Water layers deeper than this diminished or cushioned impact forces.

SWCRD, ARS, USDA, Chickasha, Okla. 73018

Rainfall simulators for erosion-control research use one of three methods for forming waterdrops. Hanging yarn and tubing-tip drop formers are limited to use in laboratory simulators and are best suited to intensive detailed studies of the effects of particular rainfall characteristics. Nozzles offer the best opportunity to duplicate the drop distribution of rainfall and are best suited for large-plot erosion studies. Development of a nozzle (and rainfall simulator) that will allow more precise rainfall simulation is needed.

Corn Belt Br., SWCRD, ARS, USDA, Morris, Minn. 56276

Hailstorms often occur in North Dakota throughout the growing season, producing varying degrees of damage to growing crops. Where the injury, or damage, is of a direct nature, the loss can be determined quite accurately soon after the storm. Where the degree of damage is not conclusive, or secondary deleterious effects develop as a result of the primary hail injury, the damages are often difficult to appraise.

An attempt was made to evaluate the results of artificially produced injury to wheat and flax plants and to measure the effects from some less obvious types of damage.

Weather conditions following the injury can be a factor in influencing differential recovery from hail damage. Retarded crop development, delayed maturity, the increased incidence of disease, or added injury from disease of high temperatures encountered because of the delayed maturity were sometimes supplemental factors to hail injury.

Recovery of wheat plants from beating or whipping was related inversely to the severity of the beating and the stage of growth. Ability of the plants to recover declined rapidly as the plants reached the jointing and boot stages. Plants with broken stems suffered less yield reduction than did beaten and bruised plants. Beating injury was most damaging from the jointing to milk stage, becoming less injurious after the kernels were more developed. Yield was decreased more by breaking than by bruising stems.

Young flax plants recovered quickly when their stems were cut, but the degree and percent of recovery decreased rapidly from such injury as the plants became older. Stem cutting was the most damaging of all treatments applied. Breaking flax stems resulted in about 40 percent yield reduction when inflicted at the blooming and soft dough stages. Stem bruising reduced the yield less than stem breaking. Damage to yield from loss of leaves was in direct relation to the stage of growth and in proportion to the amount of leaves lost.

N. Dak. Agr. Expt. Sta., Fargo, N. Dak. 58013

206. Buck, C. C., ed. WINDS OVER WILDLANDS--A GUIDE FOR FOREST MANAGEMENT. U.S. Dept. Agr., Forest Serv. Agr. Hbk. 272, 33 pp. 1964.

Wildland area management and protection are affected in many ways by the behavior of the wind. Wind distributes the seed on which natural regeneration of forest trees and range plants depends. Timber cutting practices can be varied to take advantage of this, to reduce the hazards of windthrow, or to influence snow accumulation, depending on knowledge of local winds. Patterns of damage from air pollutants are determined by the wind. Forest diseases are spread by airborne spores. Forest fires are especially sensitive to wind behavior.

Practical management often requires that the land manager or technician evaluate the winds concerned in special ways to meet his peculiar needs.

The different types of winds were described and illustrated.

FS, USDA, Inform. Div., Washington, D. C. 20250

207. Vezina, P. E., and Pech, G. SOLAR RADIATION BENEATH CONIFER CANOPIES IN RELATION TO CROWN CLOSURE. Forest Sci. 10(4): 443-451. 1964.

Observations were made in Quebec, Canada, on solar radiation available daily below canopies of Abies balsamea L. (Mill.) Pinus resinosa Ait., and Pinus banksiana Lamb., during summer and winter with Bellani radiation integrators. A relationship between crown closure and the solar radiation ratio--defined as the proportion, in percent, of the amount of solar radiation available beneath canopy (in langleys), to that available in the open--was calculated for a wide range of crown closures. Variations in solar radiation in the open did not change the average ratio in the stands, but with increasing radiation in the open the scatter of values around the mean of daily solar radiation-ratios decreased. This suggested the feasibility of a short-cut method for estimating the average solar radiation ratio in coniferous stands by integrating solar radiation on a few calm and clear days. Results were discussed in relation to the radiation-intercepting properties of forest canopies, the solar radiation requirements of Abies balsamea seedlings, and silvicultural management.

Forest Res. Br., Dept. Forestry, Canada.

208. Beaton, J. D., Speer, R. C., and Brown, G. EFFECT OF SOIL TEMPERATURE AND LENGTH OF REACTION PERIOD ON WATER SOLUBILITY OF PHOSPHORUS IN SOIL FERTILIZER REACTION ZONES. Soil Sci. Soc. Amer. Proc. 29(2): 194-198. 1965.

Pellets containing 15 mg. of P prepared from each of the following salts: KH_2PO_4 (MKP), $\text{NH}_4\text{H}_2\text{PO}_4$ (MAP), $(\text{NH}_4)_2\text{HPO}_4$ (DAP), $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O}$ (MCP), and $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$ (DCPD) were placed in cavities in the surface of Bradwell very fine sandy loam (pH = 7.8) and Monroe silt loam (pH = 5.8). The treated soils were stored at 5, 20, and 35° C. Extent of dissolution of fertilizer pellets and development of soil-fertilizer reaction zones were measured during the first 14 days of storage. At the end of 2, 7, 14, 28, and 56 days the soil-fertilizer reaction zones were sampled and the concentration of water-soluble P and the percentage of fertilizer P soluble in the reaction zones were determined.

Rate of dissolution of the water-soluble P fertilizers increased markedly as temperature increased. Some pellets were incompletely dissolved at the end of 14 days at 5° C., whereas, at 35° C., dissolution was usually complete in less than 4 days. For each 15° C. increase in temperature, there was about 33 percent reduction in concentration of water-soluble P and the proportion of fertilizer P soluble in water.

During the first 14 days after adding the water soluble fertilizers, there was a rapid decrease in concentration of water-soluble P and proportion of dissolved fertilizer P while after 14 to 28 days the changes were much smaller. Extraction of water-soluble P decreased in the order MKP>MAP = DAP>MCP>DCPD>check. Differences among sources became smaller with increased time of contact with soil. DCPD was more soluble in the acid Monroe soil than in the calcareous Bradwell soil.

Res. and Corporate Develop., The Consolidated Mining and Smelting Co. Canada, Ltd.

209. Ragland, J. L., Hatfield, A. L., and Benoit, G. R. THE GROWTH AND YIELD OF CORN. I. MICROCLIMATIC EFFECTS ON THE GROWTH RATE. Agron. J. 57(2): 217-220. 1965.

The effects of microclimatic factors on the rate of corn growth may be determined by the periodic plant harvest methods developed. However, a rather large number of plants must be taken at each harvesttime to prevent plant to plant variability from obscuring the relationships. The plant variability problem during the vegetative stage of growth was largely overcome by repeated measurements of the leaf area of the same set of plants.

The rate of leaf area increase of corn planted very early (April 8, 1963) was more correlated with temperature than any other factor measured, while the rate of leaf area growth of late-planted corn (June 10, 1963) was equally correlated with temperature and relative humidity. These correlations were all positive and highly significant in the case of the June planted corn.

Temperature, solar radiation, and water evaporation were each highly correlated with corn ear growth. The rate of ear growth followed temperature more closely ($r = 0.70$) than the other factors. Relative humidity, precipitation, and wind were not correlated with ear growth in this study. The predicted 5-cm. soil temperature at which grain growth would cease was 53° F.

U. Ky., Lexington, Ky. 40506

210. Stoeckeler, J. H. SPRING FROST DAMAGE: IN YOUNG FOREST PLANTINGS NEAR LA CROSSE, WISCONSIN. J. Forestry 63 (1): 12-14. 1965.

Observations of effects of spring freezing of May 22-23, 1963, on 13 tree species in second- and third-year plantations near LaCrosse, Wis., indicated the following sensitivity to frost injury: Very sensitive--black walnut, white ash, and red oak; moderately sensitive--Norway spruce, white spruce, and European larch; slightly sensitive--Austrian pine; not sensitive--jack pine, ponderosa pine, red pine, Scotch pine, white pine, and eastern redcedar. Some variation was noted in frost damage by altitude.

North Central Expt. Sta., FS, USDA, St. Paul, Minn. 55101

Surface Soil Removal

211. Eck, H. V., Hauser, V. L., and Ford, R. H. FERTILIZER NEEDS FOR RESTORING PRODUCTIVITY ON PULLMAN SILTY CLAY LOAM AFTER VARIOUS DEGREES OF SOIL REMOVAL. Soil Sci. Soc. Amer. Proc. 29(2): 209-213. 1965.

Greenhouse and field studies were conducted on Pullman silty clay loam to assess the relative productivities of its genetic horizons and permissible depth of cut in land leveling. German millet was grown in the greenhouse experiment. Without fertilizer, the 0- to 5-inch horizon produced highest yields. Under high N and P levels, only the 13- to 19-inch depth produced yields lower than the surface soil. The 28- to 38-inch horizon produced yields equivalent to the 0- to 5-inch horizon and greater than all other nonsurface depths studied. Trends in N and P uptake were generally similar to those in dry matter yields.

In the field experiment, N was required for maximum yields of grain sorghum on undisturbed soil and on all degrees of cut. Nitrogen and P were required when 4 or more inches of topsoil was removed and restored yields were up to 12 inches of topsoil was removed. Yields on heavily fertilized 16-inch cuts were 80 percent of those on similarly fertilized, undisturbed soil.

SWCRD, ARS, USDA, Bushland, Tex. 79012

Mulching

212. Carter, D. L., and Fanning, C. D. CULTURAL PRACTICES FOR GRAIN SORGHUM PRODUCTION THROUGH A COTTON BUR MULCH. J. Soil and Water Conserv. 20(2): 61-62. 1965.

Grain sorghum was grown on originally saline soil with a cotton bur mulch on the soil surface to aid in reducing the salinity level. Conventionally tilled and permanently bedded plots were established for comparative purposes. Stubble-mulch type sweeps were used on the mulched plots to avoid excessive disturbance of the mulch. A narrow strip directly above the seed row was left unmulched after planting to prevent the mechanical resistance to seedling emergence exerted by the cotton bur mulch. Grain yields on the mulched plots averaged 2038 lb./A. In contrast, neither conventionally tilled nor permanently bedded soils produced grain even though salt concentrations were reduced beneath the permanent furrows.

SWCRD, ARS, USDA, Kimberly (Twin Falls), Idaho 83341

213. Barkley, D. G., Blaser, R. E., and Schmidt, R. E. EFFECT OF MULCHES ON MICROCLIMATE AND TURF ESTABLISHMENT. Agron. J. 57(2): 189-192. 1965.

The effects of various mulching materials, with and without irrigation, on microclimate and seedling establishment were studied. Straw, sawdust, woodfiber cellulose (Turfiber), elastic emulsion (black Soilset), and no-mulch were each studied with Kentucky bluegrass, Kentucky 31 fescue, redbud, and check plot (without seed). Night and day temperatures were recorded with copper-constantan thermocouples and a chart-recording potentiometer. Seedling emergence, height, density, weight, and soil moisture were recorded and statistically analyzed.

Straw, sawdust, and Turfiber mulches moderated the soil temperature of the seed zone thereby improving germination, emergence, and growth of grass seedling. Soilset mulches were not beneficial to grass development. Straw mulch tended to moderate soil temperature and conserve more soil moisture than the other mulches, but not significantly more when compared with Turfiber. Weed and small grain seedlings prevalent in straw mulch caused reduced grass seedling weights. Sawdust improved turf establishment, but was easily washed off gentle slopes during hard rains. Turfiber eliminated introduction of undesirable plant species, had a favorable influence on soil temperature and moisture, increased the rate of seedling germination, emergence, and growth. Soilset conserved more soil moisture than no mulch but soil temperatures were usually higher than for no mulch.

Irrigation was usually beneficial with all grasses and mulch treatments, but of least benefit with no mulch.

Kentucky 31 fescue was apparently less sensitive to high temperatures than Kentucky bluegrass and redbud.

Va. Agr. Expt. Sta., Blacksburg, Va. 24061

PLANT MANAGEMENT

Pasture and Haylands

See Also 22, 24, 30, 34, 52, 63, 98, 101, 113, 116, 122, 125, 155, 170, 171, 179, 181, 183, 186, 191, 211, 213, 239, 241, 242, 293, 295.

214. Cooke, D. A., Beacom, S. E., and Dawley, W. K. PASTURE PRODUCTIVITY OF TWO GRASS-ALFALFA MIXTURES IN NORTHEASTERN SASKATCHEWAN. Canad. J. Plant Sci. 45(2): 162-168. Mar. 1965.

Two grass-alfalfa mixtures were compared for 7 consecutive years when continuously and when rotationally grazed by yearling Hereford steers. The productivity of rotationally grazed pastures as affected by annual application of fertilizers was also determined. Intermediate wheatgrass (Agropyron intermedium L.) and alfalfa (Medicago sativa L.) compared favorably with the standard mixture of bromegrass (Bromus inermis L.) and alfalfa for pasture purposes. Production of dry matter

ranged from approximately 2.5 to 0.5 tons/A. in the first and seventh year, respectively. Precipitation in these 2 years was 20.7 and 7.7 in., respectively. Rotational grazing did not increase beef production. Fertilization of brome-grass-alfalfa with 20 lb. N/A. and with 20 lb./N + 40 lb./P₂O₅/A. resulted in average yearly increase of 18 and 32 lb. of beef per acre, respectively. Fertilization of intermediate wheatgrass-alfalfa resulted in comparable increase of 1 and 26 lb. of beef per acre, respectively.

Expt. Farm, Canada Dept. Agr., Melfort, Saskatchewan, Canada.

215. Bryant, H. T., and Blaser, R. E. YIELD AND PERSISTENCY OF AN ALFALFA-ORCHARDGRASS MIXTURE AS AFFECTED BY CUTTING TREATMENT. Va. Agr. Expt. Sta. B. 555, 12 pp. 1964.

Yields, botanical composition, and longevity of alfalfa in an alfalfa-orchard-grass mixture were compared under 12 cutting managements. The yield of forage decreased as frequency of cutting increased. The 7-year average yield of hay (12-percent moisture) ranged from 9,930 lb. for three hay cuts, including an after-killing frost cut, to 6,910 lb. for five cuts within season (treatment I). With four cuts, the average yield was 327 lb. less when the last cut was made in October rather than September.

Three seasonal harvests, with after-frost cutting, increased yearly production 950 lb. compared to no later cutting. When four seasonal harvests were made, cutting after a killing frost gave increased yields when last seasonal harvests were made in early September.

Alfalfa survival was poorest with five annual cuttings and best with three. Cutting after frost had little effect on reducing alfalfa stands. The percent total available carbohydrates in alfalfa roots decreased with increased cutting frequency. Alfalfa roots from plants cut after frost had a lower percentage of total available carbohydrates than parallel treatments not cut after frost.

Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va. 24061

216. Smith, D. CHEMICAL COMPOSITION OF HERBAGE WITH ADVANCE IN MATURITY OF ALFALFA, MEDIUM RED CLOVER, LADINO CLOVER, AND BIRDSFOOT TREFOIL. Wis. Agr. Expt. Sta. Res. Rpt. 16, 10 pp. 1964.

Changes in chemical composition of alfalfa, red clover, ladino clover, and birdsfoot trefoil were studied during 1959-61 at Madison, Wis. Herbage was sampled at six different growth stages in both the spring and summer growths. The author concluded that:

1. Higher dry matter yields were obtained during the spring than during the summer growth period. Alfalfa and red clover produced the highest yields and were similar in yield. Trefoil yields were lower than those of ladino clover at young growth stages but higher at the most mature stages.
2. Alfalfa and red clover were similar in protein percentage, but red clover was lower in percentage of fiber. Ladino clover generally was highest in percentage of protein and lowest in percentage of fiber without much change with age. Trefoil was similar to alfalfa and red clover in protein and fiber content.
3. Percentage of fat in the spring growth was lowest in alfalfa and somewhat similar in red clover, ladino clover, and trefoil. There was a marked decrease in content with age in the spring growth in all except ladino clover.
4. Ladino clover generally was highest in percentage of ash and it changed little with age. Alfalfa, red clover, and trefoil decreased in ash content with age with red clover having the highest percentage of ash.
5. Percentage of TDN was highest in ladino clover, lowest in alfalfa, and intermediate and similar in red clover and trefoil.
6. The percentage of TDN at the young stages of growth in alfalfa, red clover, and trefoil was higher in the spring than in the summer growth. The reverse of this was the case at the mature growth stages.

7. The mineral content (P, K, Ca, Na, and Mg) of trefoil was compared with that of alfalfa. The species were similar except that trefoil was much lower in Na than was alfalfa.
8. Differences in chemical composition within a species varied among years.

Agr. Expt. Sta., U. Wis., Madison, Wis. 53706

217. Hellwig, R. E. EFFECT OF PHYSICAL FORM ON DRYING RATE OF COASTAL BERMUDAGRASS. Trans. ASAE 8(2): 253-255. 1965.

The field-drying rate of Coastal bermudagrass was determined from seven treatments: Sickle-bar mower; three conditioners--crusher, semicrusher, and crimper; tedder; and treatments were a rotary mower--one with the side up and one with the side down. The rotary mower severely altered the physical form of the hay and gave the most rapid rate of drying. However, the loss of one-half or more of the yield made this method undesirable for making hay.

The three conditioning treatments altered the physical form of the hay while the tedder produced little change; these four treatments left the hay in a fluffy swath. There was no significant difference in the drying rate of these four treatments, but about a day was saved in drying time as compared with the sickle-bar mower treatment.

AERD, ARS, USDA, Ga. Coastal Plain Expt. Sta., Tifton, Ga. 31794

218. Cooper, R. B., and Burton, G. W. FORAGE AND TURF POTENTIAL OF GIANT BERMUDAGRASS IN THE SOUTHEASTERN UNITED STATES. Agron. J. 57(3): 239-240. 1965.

Giant bermudagrass yielded no more forage than common bermudagrass and only 55 percent as much as Coastal bermudagrass whether cut weekly or at 5-week intervals. Giant bermudagrass was inferior to common bermudagrass as a turf grass. It gradually gave way to common bermudagrass when mowed but had not been eliminated after 2 years of very close, weekly mowing.

Va. Polytech. Inst., Blacksburg, Va. 24061

219. Clark, N. A., Hemken, R. W., and Vandersall, J. H. A COMPARISON OF PEARL MILLET, SUDANGRASS, AND SORGHUM-SUDANGRASS HYBRID AS PASTURE FOR LACTATING DAIRY COWS. Agron. J. 57(3): 266-269. 1965.

A grazing study with lactating dairy cows on pearl millet, sudangrass, and sorghum-sudangrass hybrid showed little difference in dry matter production, carrying capacity, or milk production. Under moist soil conditions in 1960 and 1961, the hybrid was damaged more by trampling than in the dry year of 1962.

Depression of butterfat tests in cows grazing pearl millet was statistically significant in each of the 3 years. Cows fed high levels of grain experienced depressed butterfat tests, but there was no interaction between grain levels and forage species.

Crude protein content of the forage varied by seasonal growth and no differences among forage species occurred in 1960 and 1961. In 1962, crude protein content of the pearl millet was somewhat higher than in the other two forages early in the season.

Nitrate nitrogen accumulated to a greater extent in pearl millet than in sudangrass or the hybrid in both 1961 and 1962. However, nitrate in each of the species was higher in 1961 than in 1962.

Md. Agr. Expt. Sta., Md. U., College Park, Md. 20740

220. Beaty, E. R., Smith, Y. C., McCreery, R. A., Ethredge, W. J., and Beasley, K. EFFECT OF CUTTING HEIGHT AND FREQUENCY ON FORAGE PRODUCTION OF SUMMER ANNUALS. Agron. J. 57(3): 277-279. 1965.

Gahi millet, Tift sudangrass, and sudax 11 (sorghum-sudan hybrid) were grown on Cecil sandy loam for 3 years and were harvested at intervals of 2, 3, 4, and 5 weeks at cutting heights of 1/3, 1/2, 3/4, and 7/8 of the available forage. Growth responses were summarized as follows:

1. Annual dry matter yields averaged 8446, 2399, and 6448 pounds for 1961, 1962, and 1963, respectively.
2. Harvesting at 5-week intervals produced 46 percent more forage than harvesting at 2-week intervals.
3. Harvesting 7/8 of the forage increased production 18 percent as compared to harvesting the top 1/3.
4. Gahi millet and sudax were similar in production while Tift sudangrass produced significantly less forage.
5. Gahi millet supplied more forage in the fall and more during the dry 1962 season than the other varieties.

Col. Expt. Sta., U. Ga., Athens, Ga. 30601

221. Bement, R. E., Barmington, R. D., Everson, A. C., Hylton, L. O., Jr., and Remmenga, E. E. SEEDING OF ABANDONED CROPLANDS IN THE CENTRAL GREAT PLAINS. J. Range Mangt. 18(2): 53-59. 1965.

Cultural practices required to establish crested wheatgrass, Russian wildrye, blue grama, and side-oats grama on abandoned plowed lands were investigated at the Central Plains Experimental Range near Nunn, Colo. The four species were spring planted in 1956-58, on strips of ground that had been summer fallowed, spring cultivated, or had received no preparation. The cool-season species were also planted in late summer in summer-fallowed plots and in the fall in unprepared seedbeds. Five pieces of equipment used for planting were a double-disc depth-band drill, a single-disc drill, a hoe-type drill, a lister-type planter, and a sweep-type drill. Row spacings used were 7, 12, 14, 24, 28, and 34 inches.

Blue grama and side-oats grama were not successfully established. Crested wheatgrass and Russian wildrye were successfully established by late-summer planting in summer-fallowed strips using the double-disc depth-band drill. Crested wheatgrass was also successfully established by spring planting in summer-fallowed strips using the depth-band drill. Row spacings between 7 and 28 inches had little effect on forage production.

CRD, ARS, USDA, Fort Collins, Colo. 80521

222. Petersen, R. G., Lucas, H. L., and Mott, G. O. RELATIONSHIP BETWEEN RATE OF STOCKING AND PER ANIMAL AND PER ACRE PERFORMANCE ON PASTURE. Agron. J. 57(1): 27-30. 1965.

The effect of variation in the rate of stocking on the per animal and per acre performance of grazing animals on pasture was examined. From this examination, a theory was developed which attempts to explain the relationships that existed. In general, for a given sward-animal system the theory indicates the following:

1. As stocking rate is increased gain per animal is constant at a maximum until the rate of stocking is such that the total forage consumed is equal to the total forage available. Beyond this point gain per animal is inversely related to stocking rate. As the rate of stocking continues to increase a point is eventually reached at which the animals neither gain nor lose weight. Further increases in the stocking rate beyond this point result in a loss in weight which is inversely related to stocking rate.
2. As the rate of stocking is increased there is a linear increase in gain per acre until a maximum is reached at the point at which the total forage consumed is equal to the total forage available. Beyond this point further increases in the stocking rate result in a linear decrease in gain per acre.

A feeding experiment was conducted on rats which were offered measured amounts of a standard laboratory ration. The results of this experiment showed that the theory was adequate for many purposes.

Agr. Expt. Sta., N.C. State, U. N.C., Raleigh, N.C. 27607

223. Conway, A. EFFECT OF GRAZING MANAGEMENT ON BEEF PRODUCTION: III. EFFECT OF STOCKING RATE AND GRAZING METHOD ON CARCASS MEASUREMENTS. Irish J. Agr. Res. 3(2): 165-174. 1964.

The effects of three stocking rates and two systems of grazing on carcass weight, area of eye muscle, fat cover, caul fat, killing-out percentage, gut contents, and on carcass production per animal and per acre were studied over 1961-62. Three levels of stocking (low, medium, and high) were compared under rotational and continuous systems of grazing. The results were summarized as follows:

1. Method of grazing had no effect on any of the data recorded except at the high stocking rate in 1961, when the carcasses of the rotationally grazed cattle were significantly heavier than those of the continuously grazed.
2. An increase in stocking rate caused significant reductions in carcass weight, area of eye muscle, depth of fat over eye muscle, caul fat, carcass production per animal and, in one year, on killing-out percentage.
3. When stocking rate was increased from low to medium, carcass production per acre under both grazing systems was increased. Increasing the stocking rate from medium to high gave increased production per acre under rotational grazing, but decreased it under continuous grazing.

These results were discussed in relation to carcass composition and the market requirements for beef.

An Foras Taluntais, Animal Prod. Div., Grange, Dunsany Co. Meath, Ireland.

224. Conard, E. C., and Youngman, V. E. SOIL MOISTURE CONDITIONS UNDER PASTURES OF COOL-SEASON AND WARM-SEASON GRASSES. J. Range Mangt. 18(2): 74-78. 1965.

Amounts of water in the soil to a depth of 5 feet under cool-season and warm-season grass pastures were determined several times each year during 1956-61. The results were reported in terms of inches of "available water." Soil moisture in excess of 85 percent of the amount held by the soil at 15 bars tension was considered to be available to the grasses used.

These six warm-season pastures included in pure stands--one each of big bluestem, side-oats grama, and switchgrass--and one each of these grasses in mixture with sand lovegrass. Six cool-season pastures included two each of smooth brome grass, intermediate wheatgrass, and tall wheatgrass.

There was less water in the soil under the cool-season than under the warm-season grasses in midspring each year. The amounts under the warm-season grasses ranged from 25 to 240 percent more than under the cool-season grasses. Consequently, the cool-season pastures suffered from midsummer drought more often than did the warm-season pastures.

U. Nebr., Lincoln, Nebr. 68503

225. Beard, J. B., and Daniel, W. H. EFFECT OF TEMPERATURE AND CUTTING ON THE GROWTH OF CREEPING BENTGRASS (AGROSTIS PALUSTRIS HUDS.) ROOTS. Agron. J. 57(3): 249-251. 1965.

Controlled environment studies at 60°, 70°, 80°, and 90° F., using creeping bentgrass, showed the growth rate of individual roots and total root production to be significantly reduced at 90° F. under both cut and uncut treatments. At 60°, 70°, and 80° F., there was no difference in the growth rate of individual roots but the total amount of roots produced decreased as temperature increased. Under constant soil and air temperatures of 90° F., the maintenance of an adequate bentgrass root system was adversely affected.

Mich. State U., East Lansing, Mich. 48823

226. Butler, J. L. ENERGY COMPARISONS IN PROCESSING COASTAL BERMUDAGRASS AND ALFALFA. Trans. ASAE 8(2): 175-176, 179. 1965.

High-quality alfalfa and Coastal bermudagrass were direct-cut, dehydrated, and processed into pellets; then the pellets were reground. A comparison of the energy

requirements showed that, due to the higher moisture content of alfalfa, more energy was required to dehydrate it. Although slightly more energy was required to grind alfalfa, the much larger amount of energy required to pellet Coastal bermudagrass caused its total electrical energy requirement to be greater. When the dehydrating energy was expressed in equivalent kilowatt-hours and added to the electrical energy, the total energy requirement for processing alfalfa was about 30 percent more than for Coastal bermudagrass. The alfalfa pellets were produced with less fines and were more durable and more dense than Coastal bermudagrass pellets, leading to the belief that the bonding mechanism in alfalfa was more effective than in Coastal bermudagrass.

AERD, ARS, USDA, Tifton, Ga. 31794

227. Waddington, D. V., and Baker, J. H. INFLUENCE OF SOIL AERATION ON THE GROWTH AND CHEMICAL COMPOSITION OF THREE GRASS SPECIES. *Agron. J.* 57(3): 253-258. 1965.

Merion Kentucky bluegrass (*Poa pratensis* L.), Pennncross creeping bentgrass (*Agrostis palustris* Huds.), and goosegrass (*Eleusine indica* (L.) Gaertn.) were grown in soil having oxygen diffusion rates ranging from less than 5×10^{-8} g./cm²/min. Various diffusion rates were obtained both by varying soil moisture tension and oxygen concentration of the gaseous phase allowed to come in contact with the soil.

Root growth of Merion Kentucky bluegrass was greatly reduced or stopped in soil where oxygen diffusion rates were less than 5 to 9×10^{-8} g./cm²/min. Creeping bentgrass and goosegrass roots made good growth at all levels of oxygen diffusion obtained. Although root penetration of bluegrass was decreased under conditions of low oxygen diffusion, the root weights and clipping yields were unaffected.

Nutrient accumulation was not appreciably decreased at low oxygen diffusion treatments. The similarity in growth and chemical composition of plants grown at various levels of aeration was attributed to the liberal fertilization and, in those treatments where root penetration was limited, to the high concentration of roots near the surface.

Kentucky bluegrass produced many roots at and on the soil surface when grown at soil moisture tensions of 4 and 11 cm. of water. Each grass was observed to produce thicker roots with fewer laterals under conditions of poor aeration.

Pa. State U., Col. Agr., Agr. Expt. Sta., University Park, Pa. 16802

228. Hoveland, C. S., and Webster, H. L. FLOODING TOLERANCE OF ANNUAL CLOVERS. *Agron. J.* 57(1): 3-5. 1965.

Arrowleaf, ball, berseem, crimson, and intermediate white clovers were grown in the greenhouse during a 3-month period and subject to flooding 3 days in 10, 6 days in 10, and continuous flooding. Flooding 3 days in 10 did not affect herbage yields of ball and white clovers, but it significantly reduced the yields of the other species. Crimson clover when flooded 3 days out of 10 produced only 45 percent of the well-drained check. Under more frequent flooding, ball and white clovers were most productive, crimson and arrowleaf the least productive, and berseem intermediate.

Auburn U., Agr. Expt. Sta., Auburn, Ala. 36830

229. Bayer, D. E., Hoffman, E. C., and Foy, C. L. DCPA IN HOST-PARASITE RELATIONS OF ALFALFA AND DODDER. *Weeds* 13(2): 92-95. Apr. 1965.

Preemergence applications of DCPA controlled germinating seedlings of largeseed dodder (*Cuscuta indecora* Choisy) in alfalfa, and the control continued throughout the season. Applications of DCPA were necessary prior to germination of dodder seed. Under California conditions, applications of DCPA made during early winter (December) provided early season control but not satisfactory control throughout the season as was accomplished with the March treatments. Autoradiographic studies showed only limited movement of tracer in alfalfa plants.

Agr. Expt. Sta., U. Calif., Davis, Calif. 95616

See Also 9, 32, 131, 148, 158, 187, 190, 221, 294, 308, 318, 326, 328, 330.

230. Houston, W. R. SOIL MOISTURE RESPONSE TO RANGE IMPROVEMENT IN THE NORTHERN GREAT PLAINS. J. Range Mangt. 18(1): 25-30. 1965.

A study was established in 1957 to investigate the influence of several range improvement practices on soil moisture regimes and soil moisture-herbage production relationships on native rangeland in eastern Montana. The improvement practices of rest from grazing, range pitting, and one application of nitrogen fertilizer were studied on six soils--under both heavy and light stocking rates. Measurements were made during the approximately average precipitation year 1959 and the drought year 1961.

Range pitting reduced average moisture stress (or improved moisture availability) in both years. Pitting was effective only on two clay loam soils. Rest from grazing reduced moisture stress on most clayey soils in both years, but increased it on fine sandy loam soil in 1959. The fertilizer treatment reduced moisture stress on a clay loam and silty clay loam soil and increased in a fine sandy loam. There was a strong interaction of the fertilizer treatment with soils and years.

Moisture stress was lower under heavy stocking on two treatments in 1959, but no difference was observed between stocking levels in 1961 on any treatment. Heavy stocking caused high-moisture stress on a sandy loam soil or on a southerly exposed clay loam.

Average soil moisture stress was significantly correlated with several components of herbage production. The best correlations were probably with production of perennial species and the poorest with total herbage production.

Many significant interaction effects were evident between the different combinations of treatments, years, soils, and stocking rates. Interaction effects were observed on both total soil moisture stress and the soil moisture stress-herbage production relationships.

CRD, ARS, USDA, Miles City, Mont. 59301

231. Mathis, G. W., Jaynes, C. C., and Thomas, G. W. ROOT DEVELOPMENT OF PLAINS BRISTLEGRASS AS MEASURED BY SOIL PLACEMENT OF RADIOPHOSPHORUS. J. Range Mangt. 18(1): 30-33. 1965.

Radiophosphorus was used at Lubbock, Tex., to study the extent of the root system of established rows of plains bristlegrass and to evaluate the degree of root reduction by clipping. Results showed that the root system was effectively reduced, by mowing, from 40 to 30 inches laterally and by approximately 20 inches vertically. This grass appears to be well adapted for erosion control by alternate row plantings with cultivated crops allowing for a minimum of competition for soil moisture.

Studies of translocation of radioactive phosphorus within the plant indicated that very little, if any, of the material moved across the crown of the plant.

Tex. Agr. Col, Lubbock, Tex. 77707

232. Hazell, D. B. THE CLAYPAN RANGE SITE IN NORTHERN OSAGE COUNTY, OKLAHOMA. J. Range Mangt. 18(2): 94-97. 1965.

Vegetative composition, basal density, forage production, and plant vigor were determined on a claypan range site in northern Osage County, Okla., during the summer months of June, July, and August of 1961-62.

Eleven grass species were recorded in sampling the site, with blue grama and buffalograss predominating. The presence of these short grasses was due to a dense, compacted layer of clay, located from 5 to 16 inches below the soil surface, sharply restricting the growth of tall grasses.

Western ragweed, dotted gay-feather, and heath aster, respectively, were the most abundant forbs. These species not only contributed a high percentage of the total herbage production, but also grew to a height which overshadowed and tended to obscure the grasses.

Yields of 1,800 to 2,200 pounds of dry matter per acre per season were produced on the site. Blue grama and buffalograss were the main forage producers.

Leaf growth measurements showed that height of leaf growth was one of the most consistent indicators of plant vigor. Leaf width and number of leaves, however, were shown not to be correlated with vigor.

Southeastern State Col., Durant, Okla. 74701

233. Frost, K. R., and Hamilton, L. BASIN FORMING AND RESEEDING OF RANGELAND. Trans. ASAE 8(2): 202-203, 207. 1965.

Three mechanical systems for improving success of reseeding of semi-desert ranges were developed and partly evaluated. Experience thus far indicates that: (1) Sloping fan-shaped basins are a practical device for collecting rainfall for range grass seeding if soil is suitable; (2) these basins can be formed at low cost with a tractor and blade designed for this purpose; (3) moisture penetration of 30 in. in medium soils is possible with four- or five-high-intensity storms of less than 1/2 in. each and totaling 2 in.; and (4) appropriate basins can be pressed into loose-knifed rangeland by a blister roller.

U. Ariz., Tucson, Ariz. 85721

234. Duvall, V. L., and Hilmon, J. B. NEW GRAZING RESEARCH PROGRAMS FOR SOUTHERN FOREST RANGES. J. Range Mangt. 18(3): 132-136. 1965.

In recent decades, research has brought substantial improvement in cattle and forage management of cutover forest ranges in the South. Today, massive reforestation is complicating the problems of integrating grazing with timber growing, and research aims are shifting accordingly. The current southern grazing situation was reviewed and the range research program of the U.S. Forest Service was described.

Southern Forest Expt. Sta., FS, USDA, Alexandria, La. 71301

235. Pearson, H. A. STUDIES OF FORAGE DIGESTIBILITY UNDER PONDEROSA PINE STANDS. Proc. Soc. Amer. Foresters. pp. 71-73. 1964.

To determine effects of thinning or clearcutting ponderosa pine on wood production, forage production, forage utilization, production and consumption of digestible nutrients, grazing patterns, and beef production, the timber on several hundred acres near Flagstaff, Ariz., was cut at various intensities. On four of seven study areas, it was thinned to basal areas of about 20, 40, 60, and 80 square feet per acre. On one area it was unthinned, and on two other areas it was clearcut. One clearcut unit was seeded with introduced grasses and sweetclover.

Preliminary findings indicated that herbage production was inversely related to basal area of pine stands, the relationship being logarithmic. Forage digestibility, on the other hand, was found not to be related to density of timber.

Digestibility of individual plant species varied erratically during summer, possibly in response to growing conditions. At certain periods one species was more readily digestible than another, but differences in digestibility were not consistent. The lower segments of individual plants of mountain muhly and Arizona fescue were found to be less readily digestible than the upper segments.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo. 80521

236. Klipple, G. E. EARLY- AND LATE-SEASON GRAZING VERSUS SEASON-LONG GRAZING OF SHORT-GRASS VEGETATION ON THE CENTRAL GREAT PLAINS. U.S. Forest Serv. Res. Paper RM-11, 16 pp. 1964.

A grazing experiment was conducted on the Central Plains Experimental Range near Nunn, Colo., from 1943-52 to compare: (1) Increased stocking during a 3-month early grazing period (May 10-August 10) followed by a second 3 months on other pastures that had been deferred during the early period; with (2) average stocking during a 6-month season-long grazing period (May 10-November 10).

Three groups of three pastures were used in the experiment to allow for three randomized replications of each grazing period. Each of the nine pastures was grazed for 10 years during the period assigned to it.

The number of cattle grazed for the 3-month period was approximately two times the number grazed for the 6-month period. Stocking objectives on all treatments were to make moderate utilization of the current growth of the herbage during the period of grazing.

Cattle concentrated on the early-season pastures made about the same gains each month as cattle grazing on the season-long pastures at the same time. Also, cattle concentrated on the late-season pastures made about the same gains each month as those grazing the season-long pastures. Because more cattle were concentrated in the early-grazed pastures, significantly larger average weight gains per acre were made than on the season-long pastures.

The vegetation on the early-grazed pastures suffered significant losses in herbage production. These pastures suffered mechanical damage to the vegetation and soil.

The vegetation on the late-grazed pastures also lost some in production but there was no mechanical damage.

The vegetation on the pastures grazed season-long maintained production during the 10 years of the experiment.

Rocky Mountain Forest and Range Expt. Sts., FS, USDA, Fort Collins, Colo. 80521

237. Reid, E. H. FORAGE PRODUCTION IN PONDEROSA PINE FORESTS. Proc. Soc. Amer. Foresters. pp 61-64. 1964.

From a partial review of the literature on forage production in ponderosa pine forests, the author concluded that:

1. Ponderosa pine forests are a valuable forage resource under present conditions for cattle, sheep, and big game. The forests have an average grazing capacity of about 6 acres per animal unit month for domestic livestock.
2. Herbage and browse production varied drastically with density of the tree overstory; so did utilization, and probably nutritional value of the usable understory material produced. The value of the product from livestock grazing varied from essentially zero to \$9 or more per acre per year, depending on what was done with the tree overstory.
3. Timber cutting resulted in an immediate reduction in forage and browse production through: (1) Ground disturbance; and (2) slash cover. The longtime influence was probably to increase forage production by opening the tree canopy.
4. Seeding barren areas created by logging and forest burns to adapted grasses and legumes was desirable as a method of increasing livestock and game forage and browse.
5. Because of the relationships enumerated above, it is obvious that close attention to problems of multiple-use management is imperative when planning practices for the production of trees, livestock, and wildlife in ponderosa pine forests.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo. 80521

238. Corns, W. G., and Schraa, R. J. MECHANICAL AND CHEMICAL CONTROL OF SILVERBERRY (*ELAEAGNUS COMMUTATA* BERNH.) ON NATIVE GRASSLAND. J. Range Mangt. 18(1): 15-19. 1965.

A number of chemicals including amitrol T, dalapon, dicamba, silvex, 2,4-D, 2,4,5-T, MCPA, barban, and DATC were used in exploratory trials to compare their effectiveness against silverberry vegetation on rangeland. Of these, 2,4-D, 2,4,5-T, MCPA, Silvex, and dicamba seemed to be equally and highly effective but dicamba was somewhat slower in producing visible effects. Because of its efficiency and relatively low cost, 2,4-D ester was emphasized in a variety of subsequent experiments. These involved single and repeated applications of the chemical in different seasons and years and in combination with mowing of the silverberry at different times before or after herbicidal application.

The most successful treatments, which brought about near eradication of the silverberry, were 2,4-D ester applied to 1 to 4 lb./A. in early summer, followed by a second application to new growth during the summer of the following year.

Mowing as many as three times was much less effective than a single 1 lb./A. application of 2,4-D in early summer. Mowing either some time before or after the 2,4-D treatments did not improve their results apart from some possible improvement in availability of the forage for grazing.

Addition of small amounts of certain chemicals in mixture with 2,4-D did not increase the degree of suppression of new growth from roots of treated plants.

There was no definite improvement in forage yield associated with control of the silverberry in the open stands.

U. Alberta, Edmonton, Alberta, Canada.

Plant Materials

See Also 218, 308.

239. Hawk, V. B., and Schaller, F. EMERALD CROWN VETCH--A PASTURE LEGUME. Iowa Farm Sci. 19(5-6): 71-73. 1964.

Farmers looking for a permanent pasture legume for soils too droughty for birdfoot trefoil may want to try crownvetch. It appears to have greatest possibilities on shallow soils in northeast Iowa, the Storden soils in central Iowa, and the Ida-Monona soils in western Iowa.

Crownvetch is a perennial legume that spreads underground. It has been used successfully for erosion control on steep highway banks.

Emerald-Crownvetch, characterized by its vigorous growth in both the seedling and mature plant stages, shows promise as a permanent pasture legume.

This perennial legume starts earlier in the spring than trefoil, grows rapidly, and matures seed in midsummer. Dry-matter yields tend to be intermediate between birdsfoot trefoil and alfalfa.

The primary forage-use of Emerald centers on its ability to persist on centers on its ability to persist on calcareous soils that are too droughty for birdsfoot.

Preliminary studies by animal nutritionists with sheep indicate that crownvetch is equal in feeding value to alfalfa, trefoil, or clover. There have been no reports of bloat or animal losses from grazing this plant.

While the soil adaption of crownvetch is similar to alfalfa, establishment problems are similar to those with birdsfoot trefoil. Competition must be reduced in seedling stage. A special crownvetch inoculant must be used. Seedling diseases need to be controlled by treatment with seed protectant.

The rate of seeding crownvetch when broadcast varies from 10 to 20 lb./A.

Lime, phosphorus, and potassium should be applied in accordance with the needs for alfalfa, as shown by a soil test. If an oat companion crop is used, it must be grazed or clipped.

Once established, crownvetch is vigorous, competitive with other plants, shade tolerant, and able to persist under grazing. Even though it has rhizomes (underground stems), crownvetch may be eradicated by plowing and normal cultivation.

Iowa State U. Sci. and Tech., Ames, Iowa 50010

240. Green, D. E., Pinnell, E. L., Cavanah, L. E., and Williams, L. F. EFFECT OF PLANTING DATE AND MATURITY DATE ON SOYBEAN SEED QUALITY. Agron. J. 57(2): 165-168. 1965.

The effect of date of planting and date of maturity on laboratory germination and field emergence of seed produced by early, medium, and late maturity soybeans was studied at Columbia, Mo., 1959-61.

The results indicated that soybean plants from early dates of planting, which matured during hot, dry weather conditions, produced seed with lower laboratory germination and field emergence. Seed from later dates of planting, which reached maturity after the hot, dry weather conditions had ended, generally exhibited higher laboratory germination and field emergence. In a few instances, early dates of

planting of early maturing varieties produced seed with germinability comparable to later dates of planting. Small seed size was associated with high laboratory germination, high field emergence, and later dates of planting. Green cotyledons, wrinkled seedcoats, and weather damaged or partly decayed seed were more numerous in seed from earlier dates of planting and were associated with lower laboratory germination and field emergence. Poor seed quality as indicated by high average visual ratings and high overall visual ratings was associated with low germination, low field emergence, and earlier dates of planting in all cases. The average visual rating calculated from 5 to 6 separate character ratings and an overall visual rating were approximately equal to laboratory germination tests in predicting relative field stands.

U. Mo., Columbia, Mo. 65202

241. Canode, C. L. INFLUENCE OF CULTURAL TREATMENTS ON SEED PRODUCTION OF INTERMEDIATE WHEATGRASS (AGROPYRON INTERMEDIUM (HOST) BEAUV.) Agron. J. 57(2): 207-210. 1965.

Studies were made to determine whether certain cultural practices would retard the decline in seed yield of a perennial sod-forming grass associated with increased age of stand. Intermediate wheatgrass was subjected to 10 cultural treatments and four rates of nitrogen.

Increasing the rate of N did not appear to be effective in maintaining high seed yields as the stands became older. The 4-year average seed yields indicated that 100 lb. N/A. was better than 60 lb., but was not better than 80 lb. No significant differences in the seed yields were produced by 100 and 120 lb. N. However, the latter rate had a tendency to reduce yields in all 4 years.

Burning of the straw and stubble in early September of each year was definitely a factor in maintaining high seed production. Mechanical removal of every other foot of vegetation in the row produced seed yields equal to burning. The effects of burning and mechanical thinning appeared to be additive. When amitrole was used to thin the stand, there was a serious reduction in yield in the year of application, but the yields were equivalent to mechanical thinning for the two following seed crops.

Chiseling on each side of the row to a depth of 16 to 18 inches each fall increased seed yields over the unburned check in the fifth crop year and for the 4-year average. Chiseling did not produce seed yields as high as mechanical thinning.

Thinning of the stands by burning, mechanical removal, or a combination of the two, reduced lodging and the number of culms per yard of row; resulting in a negative correlation of these factors with seed yield.

CRD, ARS, USDA, Pullman, Wash. 99163

242. Sharp, W. C. EFFECTS OF CLIPPING AND NITROGEN FERTILIZATION ON SEED PRODUCTION OF CREEPING RED FESCUE. Agron. J. 57(3): 252-253. 1965.

Seed production of creeping red fescue (Festuca rubra L.) can be improved by limiting nitrogen fertilization until slight deficiencies appear, and by reducing vegetative growth to 3 inches after each harvest. A combination of these was necessary to reduce sod binding, a factor in poor yields. Restricting vegetative growth also reduced lodging. Limiting lateral spread did not improve seed yield.

Big Flats Plant Materials Cent., SCS, USDA, Big Flats, N.Y. 14814

243. Melton, B. A. WEED CONTROL IN ALFALFA FOR SEED PRODUCTION. N. Mex. Agr. Expt. Sta. Res. Rpt. 91, 8 pp. 1964.

Neburon, Eptam, and Dacthal showed promise of being excellent preemergence herbicides for weed control in alfalfa grown for seed production.

Control of weeds during the seedling stage of alfalfa was necessary to obtain maximum seed yields.

Postemergence applications of herbicides were not effective in controlling weeds in alfalfa or in increasing seed yields to any great extent.

Dormant-season applications of diuron showed promise of being a useful tool in controlling weeds in alfalfa during each year after the seedling year.

The degree of weed control was usually reflected in a proportional manner to the yield of alfalfa seed, if a weed problem existed.

Weeds were less of a problem in broadcast plantings than in row plantings, but cultivation for weed control was possible in row plantings and not in broadcast.

Diuron was useful as a post-harvest spray in controlling volunteer alfalfa plants in a seed field.

Agr. Expt. Sta., N. Mex. State U., State College, N. Mex. 88070

244. Crawford, C. S., and Harwood, R. F. BIONOMICS AND CONTROL OF INSECTS AFFECTING WASHINGTON GRASS SEED FIELDS. Wash. Agr. Expt. Sta. Tech. B. 44, 25 pp. 1964.

The economic problems posed by insects in fields of grass grown for seed in eastern Washington led to a survey of the situation with emphasis on a study of certain grass-feeding Lepidoptera. Research was concentrated in fields east of Spokane but light-trap catches of important moths and other grass insect pest data were also obtained elsewhere. Most fields investigated were in the Spokane Valley, where irrigation is practiced, and in the foothills to the north, where fields were about 300 feet higher and not irrigated. Eighteen fields of nine grass varieties were surveyed in the summer of 1957. Five fields were studied more intensively in 1958 and four in 1959. The summer of 1960 was devoted to general observations.

Soil-inhabiting lepidopterous larvae were collected by routine soil core sampling. Adults and other insects were obtained by field sweeping and in emergence and light traps.

Larvae causing noticeable damage by feeding in the crown region were mostly Crambidae (Crambus topiarius). Heavy localized infestations of Gelechiidae (Chionodes psiloptera) were also observed. Noctuidae (Crymodes devastator) was consistently present in smaller numbers.

The biology of these three species was reported.

Control of grassfield pests was attempted by burning and by insecticides. Burning immediately after harvest would sometimes reduce webworm and cutworm populations the following spring. Burning was useful as a means of removing excessive plant residues to permit access of insecticides to soil-inhabiting pests. Heptachlor and a combination of DDT and lindane provided good control of webworms and cutworms. A preplanting soil treatment of endrin was very effective against webworms. Endrin, malathion, and phorate were effective against a grass mealybug, Heterococcus graminicola Morr.

Tables, charts, and photographs.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash. 99163

Woodlands

See Also 8, 11, 47, 62, 104, 120, 123, 124, 147, 154, 165, 196, 206, 207, 210, 234, 235, 237, 319, 328, 329, 336, 337, 358.

245. Minor, C. O. SITE-INDEX CURVES FOR YOUNG-GROWTH PONDEROSA PINE IN NORTHERN ARIZONA. U.S. Forest Serv. Res. Note RM-37, 8 pp. 1964.

Site-index curves were developed specifically for young-growth ponderosa pine in Northern Arizona. Certain newer mensurational procedures in site-curve development were also tested.

Stem-analysis data were collected on 91 sample trees in the vicinity of Flagstaff, Ariz. To evaluate the effect of density on height growth, paired trees were selected, when possible; a dominant from a dense clump, and an isolated dominant tree on the same apparent site. Only dominant trees were selected.

No consistent effect of density on height was found through the paired-tree technique. Differences in height between the paired trees could not be related to location, site, or basal area.

Owing to extreme variability in the time required (6 to 29 years in the sample trees) for local ponderosa pine to reach breast height, site curves were based upon ages at breast height rather than upon total ages.

Site curves were presented for site indices of 40 to 100 feet, ages 20 to 140 years. In the analysis of data, separate equations were calculated for each 5-foot site class. The regression coefficients were found to be linearly related to site index, however, and accordingly, site was introduced as a variable in the final equations.

The curves were field-checked on adjacent trees of varying age at 75 locations in Arizona and New Mexico. Errors in predicted site between young and old trees averaged less than 5 feet per location.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo. 80521

246. Ward, W. W., Fletcher, P. W., and Armstrong, M. A. SITE INDEX DETERMINATION--FOR BLACK CHERRY. J. Forestry 63(1): 15. 1965.

The linear relationship between tree height and logarithm of age, for trees older than 15 years, was found to be consistent among representative black cherries (Prunus serotina Ehrh.) from each of two sites. Stem analysis data from a very few trees were sufficient to establish a reliable estimate of site index.

Pa. State U., Sch. Forestry, University Park, Pa. 16802

247. Wilde, S. A., Jyer, J. G., Tanzer, C., Trautmann, W. L., and Watterston, K. G. GROWTH OF RED PINE PLANTATIONS IN RELATION TO FERTILITY OF NON-PHREATIC SANDY SOILS. Forest Sci. 10(4): 463-470. 1964.

The results were reported of a Wisconsin state-wide survey of 15- to 31-year-old plantations of red pine (Pinus resinosa Ait.), established on non-phreatic sandy soils. Stands were subdivided into three classes based on the following ranges of annual height growth (in inches)--from 7 to 13, 14 to 17, and 18 to 22. With average survival, these three classes, corresponding roughly to site indices 45, 57, and 65, were estimated to yield 12, 30, and 45 cords per acre, respectively, at age 40.

Results of multiple and simple correlation analyses revealed strong correlation between annual height growth of plantations and soil texture, content of organic matter, pH value, and available phosphorus. The contents of available potassium and of exchangeable calcium and magnesium were significantly correlated with height growth in the simple correlations, but not in the multiple correlations, apparently because they were present in quantities above the response limit.

The strong effect of phosphorus, revealed by regression analysis, was of special importance in reforestation. The effect of soil constituents on the average annual height growth (Y) was expressed by the following regression equation: $Y = -10.7 + 2.5 \text{ organic matter} + 3.5 \text{ pH} + 0.16 \text{ P} + 0.22 \text{ silt} + \text{clay content} + 0.01 \text{ K}$. The minimum level of soil fertility for planting red pine was established on the basis of the average values determined in soils supporting plantations of the medium site quality. This level of fertility promised an average height growth of 16 inches per year with an expected yield of about 30 cords per acre at 40 years.

U. Wis., Madison, Wis. 53706

248. Stark, N. NATURAL REGENERATION OF SIERRA NEVADA MIXED CONIFERS AFTER LOGGING. J. Forestry 63(6): 456-457, 460-461. 1965.

Studies of natural reproduction following logging under unit area control started in 1948 at the Stanislaus-Tuolumne Experimental Forest in California. Results from 119 permanent and 468 temporary quadrats showed that when logging preceded a good seedfall, 67 percent of the total reproduction established in the first year remained after 12 years. With rodent control, 4 percent of the 1948 seedfall gave rise to new seedlings. Bare soil or light litter in semishade made good seedbeds, but tolerance to sun and litter depth differed among species. Incense-cedar and white fir were the most common seedlings. Sugar pine comprised 10 percent of the new regeneration. Ponderosa pine seedlings grew fastest, sugar pine next, and white fir and incense-cedar, which were browsed heavily, the slowest.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif. 94720

249. Boyer, W. D. NEW LIFE FOR AN OLD FAVORITE. Southern Lumberman 209(2609): 99-101. Dec. 15, 1964.

Longleaf pine once occupied millions of acres of the Southern Coastal Plain in vast forests from Virginia to eastern Texas.

Longleaf pine is an excellent timber tree. Tall, straight, and strong, it has the heaviest and toughest wood of the four major Southern pines. It prunes itself well and so yields clear lumber in a large portion of its stem. It is highly resistant to many of the insects and diseases that affect other Southern pines and is by far the most tolerant of fire.

The extensive second-growth longleaf forests demonstrate that natural regeneration is possible. From regeneration research at Brewton, Ala., it was concluded that:

1. Maximum per-acre production of sound seeds was reached under parent overstories with densities of 35 to 50 square feet of basal area per acre.
2. Longleaf seedlings on average sites, when protected from fire, survived and remained healthy under parent overstories ranging up to 90 square feet of basal area per acre. Seedling survival after 7 years was 80 percent under 90 square feet. Seedling growth was suppressed by overstory competition, and the maximum retarding effect was approached under relatively light overstories.
3. Brown-sport, a constant threat to longleaf seedlings, was inhibited by a pine overstory.
4. Longleaf seedlings have responded promptly to release from overstory competition, even when suppressed as long as 8 years.

These findings will vastly improve the prospects for successful natural regeneration of longleaf pine. All underscore the possibilities inherent in regeneration methods based on establishment of longleaf seedlings as advance reproduction under relatively full parent overstories.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La. 70113

250. Johnson, R. L. REGENERATING COTTONWOOD; FROM NATURAL SEEDFALL. J. Forestry 63(1): 33-36. 1965.

On moist sites with an adequate seed source, eastern cottonwood was regenerated by plowing parallel ditches about 8 inches deep and 6 feet wide. Ditches were most successful in forested areas (excluding old fields) and in silt or sandy loam soils. They were made with a bulldozer blade or giant plow at one-third to one-half the cost of planting.

Southern Hardwood Lab., Stoneville, Miss. 38776

251. Mustanoja, K. J., and Leaf, A. L. FOREST FERTILIZATION RESEARCH, 1957-1964. Bot. Rev. 31(2): 151-246. \$0.35. 1965.

A review of the literature was given on forest fertilization research during 1957-64.

Reprints for sale. State U. Col. Forestry, Syracuse U., Syracuse, N.Y. 13201

252. Burton, J. D. TWENTY-YEAR RESULTS OF PLANTING EXPERIMENTS IN EAST TENNESSEE. Southern Lumberman 209(2609): 112-113. Dec. 15, 1964.

The Norris Watershed Plantations, in the Tennessee Valley about 20 miles from Knoxville, were established in 1938-39 through cooperative efforts. The objective was to evaluate the effects of different soils and aspects upon the growth of 14 tree species: Shortleaf and Eastern white pines; yellow poplar; sweet gum; white ash; black walnut; bald cypress; black locust; and white, black, bur, Northern red, Southern red, and chestnut oaks, in pure stands and in mixtures.

Thirty-six percent of the TVA land surrounding the newly dammed Norris Reservoir consisted of exhausted, eroding old cornfields and tobacco patches

occupied by weeds, broomsedge, and blackberries. All experimental plots were in these old fields. Plots were on shaly soils, cherty dolomitic soils, and limestone-derived soils, on north and south slopes. All together there were 700 plots totaling 167 acres.

Survival counts and growth measurements were made 20 years after planting.

Shortleaf had the best average survival--57 percent. White pine survival was 44 percent and yellow poplar, 41 percent. All three species achieved their best survival on the poorest soils--the dolomites.

In diameter, white pine averaged 5.7 inches, shortleaf, 5.3 inches, and yellow poplar, 3.6 inches.

White pine also led in height growth. Over all sites, it averaged 42 feet at age 20 years. Shortleaf and yellow poplar both averaged 39 feet. Shortleaf grew uniformly on all sites, but the other two leading species varied with soil and aspect. White pine averaged 44 feet tall on north slopes and 39 feet on south slopes. Yellow poplar height on limestone and shale soils was half again that on dolomite. By the fifth year practically all oak and walnut plots had been wiped out. Planted sweet gum suffered severely from rodents. Twenty-year survival of white ash and bald cypress was fair to good but very little growth occurred.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La. 70113

253. Nelson, T. C., and Chappelle, D. C. ESTIMATION OF OPTIMAL STOCKING LEVELS AND ROTATION AGES OF LOBLOLLY PINE. Forest Sci. 10(4): 471-502. 1964.

Models were developed for estimating optimal growing stock levels and rotation ages for loblolly pine. Under a profit maximization goal, they provided for varying stumpage prices, stand ages, site indexes, stocking levels, alternative rates of return, and regeneration costs for two single-product objectives. Quality differential as expressed in stumpage prices was recognized. A system was also provided for determining optimal stocking levels at the same marginal rate of return as that selected for determining optimal rotation age.

Using a loblolly pine growth study in the Southeast for the biological data, solutions of stocking levels at various alternative rates of return indicated that stocking standards for profit maximization were much less than levels which optimize physical production.

Rotation age solutions indicated that rotation lengthened as the alternative rate of return was reduced, as the site index increased, and as a quality differential was introduced.

Tables and Charts.

State U. Col. Forestry, Syracuse U., Syracuse, N.Y. 13201

254. Estep, E. M., and Hunt, D. L. LUMBER YIELD AND LOG VALUES OF WHITE FIR. U.S. Forest Serv., Res. Paper PNW-20, 35 pp. 1964.

Lumber grade recovery from 284 southern Oregon white fir logs was determined in a cooperative study conducted in 1961. Value of the lumber from each log was used to compute values of individual log grade-log diameter classes. Methods used to collect lumber grade yield data allowed development of basic log value information applicable to grading and scaling practices used both east and west of the Cascade Range.

Effect on lumber yield of: (1) Log diameter; and (2) log grade was illustrated in curves which related lumber value and log value to log size and quality. Overrun and defect observed in the study logs were graphically shown.

Tables and graphs.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Ore. 97203

255. Wellner, C. A. THE IMPACT OF MULTIPLE USE ON SILVICULTURE IN THE NORTHERN ROCKY MOUNTAIN AND INTERMOUNTAIN REGIONS. Proc. Soc. Amer. Foresters, Denver, Colo. pp. 20-22. 1964.

Multiple use is only beginning to have impacts on silviculture in the northern Rocky Mountain and Intermountain regions. Because timber use was one of the first major forest uses, timber growing and harvesting practices are further developed than management for many other uses.

The effect of multiple use on silviculture means that production will be maximized for all uses rather than for timber products alone. These impacts, in these regions, are bound to reduce volumes of wood available for timber products. Timber growing costs at times will be increased by these impacts, but the opposite could be true if the other uses carried their full share of costs.

Whether forests of the northern Rocky Mountain and Intermountain regions are managed for timber, water, recreation, food for wildlife and domestic livestock, or a combination of these products, they will require definite, purposeful management. Each use or product requires a special silviculture to maximize that use. A blending of uses requires very skillful adaptation and coordination of silvicultural practices.

In multiple use management, it is not the impact of multiple use itself on silviculture that is of concern, but rather the effect of one use on another.

Most forest lands of the northern Rocky Mountain and Intermountain regions are dedicated to multiple use. Even areas reserved primarily for recreation also produce water and food and cover for wildlife.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah 84403

256. Wooldridge, D. D., and Weaver, H. SOME EFFECTS OF THINNING A PONDEROSA PINE THICKET WITH A PRESCRIBED FIRE. II. J. Forestry 63(2): 92-95. 1965.

Six years after prescribed burning in young ponderosa pine, height growth of crop trees was reduced and their diameter growth was not different from that of an unburned area. Prescribed burning definitely resulted in thinning from below.

The results failed to verify findings from an earlier study of a nearby area in which height and diameter growth of crop trees had been stimulated after prescribed burning.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg. 97208

257. Alexander, R. R. GROWTH OF THINNED YOUNG LODGEPOLE PINE IN COLORADO. J. Forestry 63(6): 429-433. 1965.

Two kinds of thinnings were made. Uniform thinning reserved 630 trees per acre, spaced an average of 8.5 feet apart. Crop-tree thinning released approximately 100 trees per acre, spaced an average 21 feet apart, by cutting openings 16 feet in diameter around each selected tree.

Thinnings stimulated diameter growth of the best 100 trees under both treatments and of all trees on the uniformly thinned plots. Height growth was unchanged. Basal area increment was unaffected. Thinning initially reduced total cubic-foot volume increment; but, after 8 years, growth was the same on thinned and unthinned plots. Volume in pulp-wood-sized trees was increased only by uniform thinning. The uniform method best met the objectives of thinning. Earlier stumpage returns were indicated, and total stand growth would be redistributed on fewer but better quality stems.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo. 80521

258. Fenton, R. H. ROOT GRAFTS AND TRANSLOCATION OF 2,4,5-T IN YOUNG SWEETGUM STANDS. J. Forestry 63(1): 16-18. 1965.

Backlash mortality of untreated trees was observed in New Jersey sweetgum stands where 2,4,5-T had been applied with injectors in experimental thinnings. Translocation of the herbicide from treated to untreated trees was attributed to

root grafts, which were verified by excavation. Injector thinnings still seem feasible, so long as treated stems were at least 1-1/2 feet away from crop trees.

Northeastern Forest Expt. Sta., FS, USDA, New Lisbon, N.J. 08064

259. Webster, H. H. PROFIT CRITERIA AND TIMBER MANAGEMENT. J. Forestry 63(4): 260-266. 1965.

Economic studies in timber management often rank opportunities in terms of relative profitability which may help forest managers spend funds in an effective manner. Different profit criteria may be used.

A case study was made to appraise the practical, as opposed to theoretical, importance of differences among profit criteria. Twenty-three timber management opportunities were ranked according to different criteria, including internal rate of return. Contribution-to-present-net-worth and value-response-per-cost-dollar each at two different interest rates, and pay-out period used in two different ways. Practical differences among profit criteria were tested with opportunities that are mutually exclusive.

U. Wis., Madison, Wis. 53706

Management of Coffee Plantations

260. Firman, I. D. A REVIEW OF LEAF RUST AND COFFEE BERRY DISEASE CONTROL IN KENYA. Trop. Agr. 42(2): 111-119. 1965.

Considerable progress has been made in the control of the two main diseases of Coffea arabica L. in Kenya. A review of the literature was given of work carried out during the last 10 years. In addition to leaf rust (caused by Hemileia vastatrix Berk. & Br.) and coffee berry disease (caused by Colletotrichum coffeanum Noack), a section of Elgon dieback was also included since it has the same causal organism as coffee berry disease.

Col. Sci. and Tech., Ashley Down, Bristol, England.

Fruit and Nut Crops

See Also 119, 180.

261. Jones, W. W., and Cree, C. B. ENVIRONMENTAL FACTORS RELATED TO FRUITING OF WASHINGTON NAVEL ORANGES OVER A 38-YEAR PERIOD. Proc. Amer. Soc. Hort. Sci. 86: 267-271. 1965.

Yearly variations in yields of Washington navel oranges in California have been observed for many decades. The variation extends from extremely large crops to almost complete crop failures. Yield data and yield-weather relationships were presented for the period 1926-64 from trees planted in 1917 which have had uniform culture. During this period, yields have increased ($r = 0.491^*$), and the total yield averaged almost 4 tons of fruit per tree. From year to year, yields have varied from 58- to 330-lb./tree. These yearly variations were highly correlated with the crop load of the previous year and with the single-day maximum temperature between May 10 and June 30, the period following bloom.

U. Calif. Citrus Res. Cent., Agr. Expt. Sta., Riverside, Calif. 92502

262. Kender, W. J. SOME FACTORS AFFECTING THE PROPAGATION OF LOWBUSH BLUEBERRIES BY SOFTWOOD CUTTINGS. Proc. Amer. Soc. Hort. Sci. 86: 301-306. 1965.

A factorial experiment was conducted to study the influence of clone, of type of cutting wood and season, and of a rooting hormone on the rooting of lowbush blueberry softwood cuttings. Excellent rooting, up to 99 percent, was obtained if cuttings were made under optimum conditions. Cuttings taken in late June and early July, when the shoots were in active growth, had a high-rooting capacity. After

terminal dieback occurred (July 10) and shoot elongation ceased, cuttings rooted poorly. Marked differences in rooting capacity were found among the three clones studied. Cuttings made from vegetative shoots arising from underground rhizome buds rooted consistently better than those made from 1-year old aerial stems. Indolebutyric acid had no influence on the induction and development of roots.

U. Maine, Orono, Maine. 04473

263. Woodbridge, C. G., and Clore, W. J. A BLACK-LEAF CONDITION OF CONCORD GRAPES IN WASHINGTON. Proc. Amer. Soc. Hort. Sci. 86: 313-320. 1965.

A black-leaf condition of Concord grapes was shown to be generally associated with a low K content of affected tissues. Sprays containing K were not effective in lessening or curing the condition. Soil applications of relatively large amounts of K_2SO_4 partly alleviated the condition only after 2 years. Good correlations were noted between the extent of black-leaf and tissue K but not between black-leaf and soil K in vineyards.

Wash. State U., Pullman, Wash. 99163

264. Sharples, G. C., Todd, F. E., McGregor, S. E., and Milne, R. L. THE IMPORTANCE OF INSECTS IN THE POLLINATION AND FERTILIZATION OF THE CARDINAL GRAPE. Proc. Amer. Soc. Hort. Sci. 86: 321-325. 1965.

Cardinal grapevines exposed to insect pollination had significantly fewer shot-berries and seedless berries and more seeds per berry than vines caged to exclude insects, but the differences were of no practical value. Increasing pollinator activity by confining a honey bee colony within the cages was no more effective than exposure to natural pollinator activity. A highly significant correlation was found for seed content versus berry weight, including shot-berries but only 61 percent of variation in berry weight was accounted for by differences in seed number.

U. Ariz., Agr. Expt. Sta., Tucson, Ariz. 85721

265. Tate, H. F. GROWING GRAPES IN ARIZONA. Ariz. Agr. Expt. Sta. B. A-33, 24 pp. 1965.

A "culture and care" publication was given on the growing of grapes in Arizona.

Photographs and Charts.

Coop. Ext. Serv., and Agr. Expt. Sta., U. Ariz., Tucson, Ariz. 85721

266. Booster, D. E., and Bullock, R. M. MECHANICAL HARVESTING OF CANE FRUITS. Trans. ASAE 8(2): 170-174. 1965.

Mechanized equipment did not automatically guarantee a solution to all cane fruit harvesting problems. Successful mechanical harvesting required good cultural practices be followed in growing the crop. The systems of trellising trailing berries had to insure that the fruit was accessible to the mechanical picking device. The best in weed control had to be used because it was virtually impossible to remove certain weed seeds from the harvested fruit. Disease control, tillage, irrigation, and selection of planting site were also important.

Harvesting is one phase of cane fruit production that has been slow to change over the years. A major part of the total production is still harvested by hand. If the current economic trends and attitudes continue, mechanical harvesting of these crops will have increased importance in the future.

Oreg. State U., Corvallis, Oreg. 97331

267. Gilbert, F., Holm, L., and Rake, L. THE GROWTH OF RED TART CHERRY TREES WITH ANNUAL APPLICATIONS OF SIMAZINE AND DIURON. Weeds 13(1): 11-12. 1965.

The growth and development of newly planted red tart cherry trees on a silt loam soil were satisfactory following six annual treatments of 2.5, 5, and 10 lb./A. of simazine or 2.5 lb./A. of diuron. Measurements of tree diameter and leaf area gave no evidence of injury. The control of annual and perennial weeds was excellent. In survey experiments, trees which received 80 lb./A. of simazine in 4 years were not injured, but 160 lb./A. in 4 years produced leaf injury in the fourth and fifth years.

Wis. Agr. Expt. Sta., U. Wis., Madison, Wis. 53706

268. Dana, M. N., Skroch, W. A., and Boone, D. M. GRANULAR HERBICIDES FOR CRANBERRY BOGS. Weeds 13(1): 5-7. 1965.

Early spring or late fall treatments of dichlobenil were effective for the control of several annual and perennial sedges, grasses, and broadleaf weeds in cranberry bogs. CIPC, 2,4-D, and simazine as spring applications were less effective than dichlobenil for the wide spectrum of weeds encountered. Single spring applications of as much as 4 lb./A. of dichlobenil, 6 lb./A. of 2,4-D, 24 lb./A. of CIPC, and 2 lb./A. of simazine were tolerated by the cranberry vines. Dichlobenil at 4 and 6 lb./A. caused reductions in upright growth and fruit size. Keeping quality of mature fruit was not adversely affected by herbicidal rates of any of the materials.

U. Wis., Madison, Wis. 53706

269. Raski, D. J., Hart, W. H., and Kasimatis, A. N. NEMATODES AND THEIR CONTROL IN VINEYARDS. Calif. Agr. Expt. Sta. C. 533, 23 pp. 1965.

Information was given on nematodes in vineyards. The following factors were discussed: (1) General description of nematodes; (2) how they injure plants (3) what species are found in California vineyard soils; (4) brief life histories of prevalent species; and (5) control measures, including preplant and postplanting soil fumigation, and use of resistant rootstock varieties.

Tables and photographs.

Calif. Agr. Expt. Sta., U. Calif., Davis, Calif. 95616

Field Crops

See Also 21, 30, 31, 35, 36, 43, 52, 54, 65, 66, 69, 101, 111, 112, 116, 118, 119, 126-129, 132-134, 151, 155, 157, 176, 182, 184, 185, 191, 196, 205, 209, 211, 212, 240, 286, 288, 293, 296-298, 351, 357.

270. Lehane, J. J., and Staple, W. J. INFLUENCE OF SOIL TEXTURE, DEPTH OF SOIL MOISTURE STORAGE, AND RAINFALL DISTRIBUTION ON WHEAT YIELDS IN SOUTHWESTERN SASKATCHEWAN. Canad. J. Soil Sci. 45(2): 207-219. June 1965.

In dry seasons, wheat yields were higher on clay than on loam and sandy loam soils for equal amounts of moisture used. In wetter seasons, yields were higher on both clay and loam than on sandy loam.

Grain yields were little influenced by the amount of moisture stored in the 0- to 6-in. and 6- to 12-in. layers at seedtime, but they were increased markedly by the moisture stored below the 12-in. depth.

Multiple regression equations taking into account rainfall distribution during the season gave better estimates of yield than did equations using total seasonal rainfall only. Rainfall received during June and July and available moisture stored below 12-in. depth were important factors influencing grain yield on all soils.

Expt. Farm, Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

271. Butcher, W. R., Gilbert, H. A., and Brough, O. L., PRODUCTION CONTROL ALTERNATIVES: THEIR EFFECT ON WASHINGTON WHEAT FARMS. Wash. Agr. Expt. Sta. B. 656, 16 pp. 1964.

Alternative wheat output control and price support programs were investigated for the effect upon production and net returns of typical wheat farms. Six programs were considered: A program of allotments and supports as in 1959-60; two alternative acreage allotment programs; two bushel-marketing-quota programs; and a program of no controls and no support. Farms of three different sizes were studied for both the wheat-pea and wheat-fallow areas of Washington. Outcomes under the various alternatives were calculated by budgeting.

As a general rule, the effect of a program on production was to alter the proportions of wheat and barley in total grain output. An exception was that the program with a land retirement feature lowered total grain production on farms in both areas. Programs permitting unlimited production of wheat (to be sold at a feed value price) increased total grain production as wheat was substituted for the lower-yielding barley. The increase in total output, most noticeable on the wheat-pea farms, might be large enough to affect the feed grain market in wheat areas.

The pattern of expected net returns under the various programs was virtually the same in both areas. The marketing-quota multiple-pricing programs gave highest net returns. The program of no controls and no supports gave the lowest net returns. Farm size affected the level of net returns per acre but did not alter the pattern of comparative returns among the various programs.

The effect of an association between yield and allotment was also considered. If yields rise as allotments are reduced, a standard income can be obtained with a lower support price than would be possible if yields were unaffected by the size of allotment.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash. 99165

272. Price, P. B., and Pederson, V. D. WINTER BARLEY SURVIVAL IN CHLOROPICRIN-TREATED AND N-FERTILIZED SOIL. Agron. J. 57(2): 199-201. 1965.

Summer-fallowed field plots of Williams loam were untreated, fumigated with chloropicrin, fertilized with N, or given a combined fumigation-N fertilizer treatment. These treatments were applied 1 month (August 15) or 5 days (September 10) before seeding with Kearney or Chase winter barley.

Winter survival of both varieties seeded on these plots was increased by chloropicrin and combined chloropicrin-N treatments. Highest survival of both varieties was obtained with combined treatments applied September 10.

Statistically significant increase in $\text{NO}_3\text{-N}$ level was obtained in N-fertilized soils and combined chloropicrin-N treatments. A non-significant increase of $\text{NO}_3\text{-N}$ was obtained in chloropicrin-treated soils.

CRD, ARS, USDA, Brookings, S. Dak. 57007

273. Mann, H. O. EFFECTS OF RATES OF SEEDING AND ROW WIDTHS ON GRAIN SORGHUM GROWN UNDER DRYLAND CONDITIONS. Agron. J. 57(2): 173-176. 1965.

Effects of varieties, rates of planting, and row widths on yields of dryland grain sorghum were studied during a 3-year period (1960-62). Varieties tested were Early Hegari, Martin, and RS 610. Seeding rates were 2, 4, and 6 pounds of seed per acre (85 to 95 percent pure live seed). Row widths were 21 and 42 inches.

Grain yield of the RS 610 hybrid for the 3-year period was significantly higher than yields of either Martin or Early Hegari at all rates of seeding. Highest average yields were obtained at the 2-pound rate of seeding. The RS 610 hybrid was consistently high at this rate.

The 2-pound rate corresponded to average plant populations of 15,300 in 42-inch rows and 19,900 in 21-inch rows. The results suggest that it would be a waste of seed, especially for hybrids, to plant more than 4 pounds per acre under dryland conditions similar to those represented. The RS 610 hybrid had higher plant populations at all comparable seeding rates and row widths than either Early Hegari or Martin.

Yield difference between 21-inch and 42-inch rows was not significant. However, 21-inch rows showed advantages over 42-inch rows in competition with weeds as well as for prevention of wind erosion.

Southeastern Colo. Br. Expt. Sta., Springfield, Colo. 81073

274. Csorba, J. J., and Kirkbride, J. W. HARVESTING OF CORN, SMALL GRAINS, AND RELATED CROPS: DATA ON PRACTICES. U.S. Dept. Agr., Econ. Res. Serv., Statist. Rpt. Serv. Statist. B. 354, 53 pp. 1964.

Harvesting of corn, small grains, soybeans, and sorghums by combines continues to increase. Combining of small grains in the United States increased from about 84 percent of the total production in 1950 to 97 percent in 1960. During the same period, combining from windrow increased from 22 to 27 percent of the total; but the largest gain was in harvesting by combine from standing stalk, from about 62 percent of the small grains harvested in 1950 to 70 percent in 1960.

Harvesting small grains with combines from windrow is most important in the northern section of the United States. It increased considerably from 1950 to 1960 in the Northern Plains and the Lake States. In most other States, however, combining from windrow has dropped or is a very small part of the total harvesting operation.

Cornpicking attachments on grain combines are being used increasingly in the major corn-producing areas. In 1956, only 3 percent of the corn harvested was field shelled, but this increased to about 15 percent by 1960. Field shelling was highest on farms with a large acreage of corn. A similar relationship was found for harvesting by mechanical picker, except that the importance of mechanical picking dropped slightly in all areas on farms with over 300 acres of corn harvested.

Field shelling of corn will continue to increase. Domestic shipments of cornpicking attachments for combines and cornpicker shellers numbered under 5,000 units in 1956, but shipments have averaged between 9,000 and 10,000 units annually since 1956.

Tables and Charts.

OMS, USDA, Inform. Div., Washington, D.C. 20250

275. Duncan, W. G., Hatfield, A. L., and Ragland, J. L. THE GROWTH AND YIELD OF CORN. II. DAILY GROWTH OF CORN KERNELS. Agron. J. 57(2): 221-223. 1965.

The day-to-day dry weight growth of corn kernels in this experiment was positively correlated with average air temperature and relatively independent of solar radiation.

The stalk was an important storage organ for sugar which, under some conditions, can be translocated to maintain dry weight growth of the kernels for extended periods in the absence of photosynthesis.

It seems probable that sugar storage in the stalk provides most of the reservoir of readily mobile sucrose required to maintain relatively uniform kernel growth in spite of wide diurnal and day-to-day variation in photosynthesis.

U. Ky., Lexington, Ky. 40506

276. Shaw, L. PRIMING AND MATURITY STUDIES ON BURLEY TOBACCO IN WESTERN NORTH CAROLINA. N.C. Agr. Expt. Sta. Tech. B. 164, 35 pp. 1964.

Compared with all-stalk-cut plants, priming three to five leaves from the bottom of burley tobacco plants with the balance of the plant stalk-cut, increased acre yields of cured leaf. Priming farther up the stalk had no major additional effect on yield. The increased yields from priming resulted primarily from saving tobacco from the bottom of the plants which was either lost or badly damaged on all stalk-cut plants. There was some tendency toward a gain in yield in the lug and bright leaf grades on the stalk-cut portions of partly primed plants, as compared with the same grades from the same position on all-stalk-cut plants.

Mean values per hundredweight in all tests were increased on plants primed at the bottom in comparison with all-stalk-cut plants.

Acre values were influenced by both acre yields and values per hundredweight.

Using weighted composites of all grades, the moisture equilibrium at 60 percent relative humidity, specific volume, and pH of the cured tobacco were not altered by priming as compared with all-stalk-cured. The percent CaO, K₂O, and Cl did not differ between primed and unprimed plants. The percent total nitrogen, alpha-amino nitrogen, nicotine, total volatile bases, and total volatile bases minus nicotine were increased by priming, as compared with all-stalk-cut. Most of the increase in nitrogenous constituents, except nicotine, was in the primed leaf from the lower one-fifth of the plant.

Tables and photographs.

Agr. Expt. Sta., N.C. State, U. N.C., Raleigh, N.C. 27607

277. Bennett, O. L., Ashley, D. A., Doss, B. D., and Scarsbrook, C. E. INFLUENCE OF TOPPING AND SIDE PRUNING ON COTTON YIELD AND OTHER CHARACTERISTICS. Agron. J. 57(1): 25-27. 1965.

Field studies were conducted at Thorsby, Ala., on a Greenville fine sandy loam to determine the effects of topping and side branch pruning of cotton plants grown under irrigation and high fertilization on lodging of plants, boll rot, yield, and fiber quality. Annual applications of 300, 92, and 175 pounds per acre of N, P, and K, respectively, were applied. Irrigation was applied before 50 percent of the available moisture in the surface 2 feet of soil was used.

Plant lodging was almost eliminated and boll rot was reduced by topping or by combinations of topping and pruning of side branches. Topping plants controlled lodging more effectively than pruning of side branches alone. Altering plant geometry by topping plants at a height of 36, 42, or 48 inches or by pruning side branches increased yields. Fiber length was increased by topping plants at 48 inches both years. Micronaire was not affected in 1960 but was increased by altering plant geometry in 1961. Fiber elongation and fiber strength were not consistently affected by altering plant geometry.

SWCRD, ARS, USDA, Morgantown, W. Va. 26500

278. Porterfield, J. G., Batchelder, D. G., and Taylor, W. E. COTTON STRIPPER CONVEYORS. Okla. State U. Expt. Sta. Tech. B. T-111, 46 pp. 1964.

Two classes of tests were made with cotton stripper conveyors over a 5-year period. Laboratory tests furnished data for evaluating some of the factors important in removing trash from burr cotton during conveying. Ginning tests were performed to evaluate the effects of both cleaning and boll breaking accomplishments during conveying on the ginning characteristics of burr cotton and on the properties of the ginned lint.

Laboratory results showed that the cylinder conveyor removed more of all trash components than the auger conveyor at any given set of operating conditions.

Increasing shaft speed enhanced the effectiveness of trash removal in the cylinder conveyor, but decreased the effectiveness of the auger conveyor.

Increasing feed rates reduced the effectiveness of removal of all trash components except burrs by the cylinder conveyor.

Ginning results showed that after passing through the test conveyors, the total trash content of the burr cotton varied depending on which conveyor was used, but the differences were nearly eliminated after passing through the gin machinery.

Trash removal appears to be a desirable characteristic of burr cotton conveyors, particularly if it can be accomplished without rejecting lint with the trash. Greatest trash removal was obtained from the cylinder conveyor equipped with the parallel grid bar screen surface, operated at 500 r.p.m. and at a feed rate of 20 lb. per minute.

Boll breaking appeared to be a desirable function of burr cotton conveyors insofar as the effects of increased lint recovery exceeded the effects of reduced unit lint values.

The cylinder conveyor was superior to all others in boll breaking. Boll breaking was three times more influential than cleaning in increasing net returns per acre.

Tables, graphs and photographs.

Okla. State U., Expt. Sta., Stillwater, Okla. 74075

279. Bawson, J. H., and Bruns, V. F. CHEMICAL CONTROL OF ANNUAL WEEDS IN FIELD BEANS. Wash. Agr. Expt. Sta. B. 655, 16 pp. 1964.

EPTC at 3 lb./A. provided excellent control of most annual weeds in field beans when thoroughly incorporated with a disk or rototiller into the surface 3 to 6 inches of soil.

EPTC is relatively short-lived in the soil and does not persist up to harvest-time. Season-long weed control from EPTC depended on normal bean growth to control weeds by competition in the latter part of the season.

Beans were not permanently injured by EPTC at 3 to 6 lb./A. in sandy loam soils. Cool weather after planting sometimes led to temporary injury from which the plants recovered fully and yielded normally.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash. 99163

280. Burnside, O. C., and Kittock, D. L. WEED CONTROL IN CASTORBEANS. Weeds 13(2): 130-133. Apr. 1965.

Castorbeans (Richinus communis L.) are extremely tolerant of the rotary hoe. Timely use of the rotary hoe plus cultivation gave effective weed control in castorbeans. The preemergence herbicides, used either alone or in combination, that appeared most promising for selective control of weeds in castorbeans were: CDAA, DCPA, EPTC, NPA, trifluralin, and propyl dipropylthiolcarbamate (R-1607). The most dependable weed control practice in castorbeans was the use of preemergence herbicides in combination with rotary hoeings plus cultivation.

U. Nebr., Lincoln, Nebr. 68503

281. O'Bannon, J. H., and Reynolds, H. W. WATER CONSUMPTION AND GROWTH OF ROOT-KNOT-NEMATODE-INFECTED AND UNINFECTED COTTON PLANTS. Soil Sci. 99(4): 251-255. 1965.

Root-knot-nematode-infected and uninfected Pima S-2 cotton plants were grown under two systems of irrigation to study water consumption and plant growth. In one, soil moisture was maintained near field capacity through autonomous irrigation. In the other, soil moisture was brought to field capacity at intervals determined by weighing (allonomous irrigation). In autonomous irrigation, both water consumption and plant growth of the infected plants were as great or greater than of uninfected plants. In allonomous irrigation, infected plants were severely restricted in growth, and water consumption was significantly less than in infected plants.

Where water is not a limiting factor, sufficient water for plant growth moves to the upper portions of the plant even when roots are severely galled. When plants are irrigated at intervals and soil moisture is not always maintained at field capacity, infected roots are not able to transmit sufficient water to the plant to maintain normal growth.

CRD, ARS, USDA, Tempe, Ariz. 85281

See Also 33, 102, 119, 127, 158, 173, 177, 288.

282. Timm, H., and Schweers, V. H. EFFECT OF TEMPERATURE AND SEED TREATMENT ON RESPIRATION, SPROUTING, AND DECAY OF SEED POTATOES. Proc. Amer. Soc. Hort. Sci. 86: 502-510. 1965.

The respiratory rate, sprouting, and incidence of decay in "White Rose" seed potatoes differentially treated and held at different temperatures were studied. Freshly cut tubers respired at two to four times the rate of whole or subsized cut tubers. The greater the area of wounded tissue, the higher was the rate of respiration. At 35° C., unsprouted or partly sprouted tubers that were cut and treated with gibberellic acid (GA) respired more than did well-sprouted tubers similarly treated. Seed tubers held at 35° C. for 96 hours exhibited temporary sprout inhibition after transfer to 20° C.

Incidence of decay was highest at 35° C. in cut, sprouted tubers, but declined at temperatures below 35° C. in both cut and whole tubers. Treatment with GA enhanced decay in cut seed.

U. Calif., Davis, Calif. 95616

283. Neubauer, L. W., Hoyle, B. J., and Kucera, E. EFFECT OF METHODS OF STORAGE ON SUBSEQUENT GROWTH AND YIELD OF SEED POTATOES. Trans. ASAE 8(1): 138-140. 1965.

A delicate balance of controls may be necessary during an extended period of potato storage, depending on the expected market, such as table potatoes, chips or other processing, and seed potatoes. The more significant results of this research may be stated as follows.

1. The most favorable storage temperatures appeared to be 40° to 42° F.
2. Sprout growth in late storage was greatly reduced by using ventilation rates of 2 to 3 c.f.m. per bushel of potatoes, at 93° F.
3. Mold in storage was also eliminated by using these high air rates.
4. Chips were poor under high ventilation conditions. Good chips resulted after low (0 to 0.60 c.f.m./bu.) air rates.
5. Strong ventilation was helpful, especially for late-planted potatoes.
6. Bruised potatoes were more critical in storage. Large potatoes were grown from seed stored under moderate and strong ventilation.
7. Following non-ventilation storage, more deformed potatoes were grown than after high air rates.
8. Precut seed potatoes suffered as much as 26 percent water- and weight-loss in storage under strong air rates. With no ventilation, 10 percent of weight was lost.
9. Decay loss was higher after strong ventilation.
10. Decay was affected by temperature; least at 41-1/2° F. and most at 35° F.
11. Sprout loss, was least at 35° F. and increased with the temperature of the storage.

U. Calif., Davis, Calif. 95616

284. Maier, M. G., and Loftsgard, L. D. POTATO PRODUCTION COSTS AND PRACTICES IN THE RED RIVER VALLEY. N. Dak. Agr. Expt. Sta. B. 45, 31 pp. 1964.

Basic production data was presented and analyzed for determining the economic role of potatoes in the operations of Red River Valley farms.

Data were gathered by the personal interview process during the summer of 1961. The sample included 82 farms grouped on the basis of their potato acreage. The small-sized group had 20 farms with 95 to 160 potato acres, the medium-sized group was made up of 39 farms with 161 to 320 potato acres, and the large-sized group consisted of 23 farms with a range of 320 to 1,005 potatoes acres.

Certified seed was planted on 78.8 percent of the acres at a usual seeding rate of 12 to 13 hundredweight. Potato seed was usually machine-cut and 79.2 percent was treated before planting. More than one-fourth of the planters in use were four-row.

Fertilizer was used by all but one of the 82 growers in the study.

The predominant method of harvest was the direct method. Average acreage per harvester was 131, 230, and 300 acres, respectively, for the small, medium, and large growers. Growers with 400 or more acres of potatoes in most cases owned 2 harvesters.

Slightly more than one-fifth (22.7 percent) of the potato acres were recertified and 6.9 percent of the acres were contracted for sale.

The total per acre costs of production were \$107.35, \$105.35, and \$104.45 for the small, medium, and large growers, respectively. The average per acre variable cost of all growers in the study was \$79.25, and the average fixed cost was \$25.90 per acre.

Average per acre fixed cost decreased from \$30.40 for the small growers to \$24.00 for the large growers. The average per acre variable cost increased somewhat from \$76.95 for the small size group to \$80.45 for the large size group.

Existing economies of size are due primarily to economies of machine ownership. The per acre investment was \$68, \$60, and \$51, respectively for the small, medium, and large growers.

The machine ownership costs were \$18.40, \$15.10, and \$12.00 per acre for the small, medium, and large growers, respectively.

Tables, graphs, and photographs.

Agr. Expt. Sta., N. Dak. State U., Fargo, N. Dak. 58103

285. Stewart, F. B. ROW SPACING OF DETERMINATE, BUNCH-TYPE SOUTHERN PEAS. Proc. Amer. Soc. Hort. Sci. 86: 484-486. 1965.

A bunch type southern pea (Virginia 61-5 Blackeye) was grown 2 years in rows of various spacing on a Woodstown gritty fine sandy loam soil. Yield of green pods increased with decreasing row width. The mean yields for both years were 5,438, 4,840, 4,583, 4,145, and 3,895 lb./A. of pods at green shell maturity for rows spaced at 18, 24, 30, 36 and 42 inches, respectively.

Va. Truck Expt. Sta., Norfolk, Va. 23501

286. Mack, H. J. EFFECT OF TOPPING ON YIELD OF SWEET CORN. Proc. Amer. Soc. Hort. Sci. 86: 411-414. 1965.

Topping reduced sweet corn yields in tests in Oregon in 1960-62. The magnitude of yield loss depended upon the severity and time of topping. Yield reductions were greatest when all the leaves and the stalk were cut off above the uppermost ear at full-silk. Generally, the earlier the topping was done the more severe the loss.

Oreg. State U., Corvallis, Oreg. 97331

287. Taylorson, R. B. NEW HERBICIDES FOR SWEET POTATOES. Proc. Amer. Soc. Hort. Sci. 86: 517-522. 1965.

Six herbicides were applied on newly set sweet potato slips in Georgia. The herbicides EPTC at 7.5 lb./A., PPTC at 7.5 lb./A., diphenamid at 5 lb./A., and amiben at 4 lb./A. gave satisfactory weed control without appreciable injury to sweet potato plants. Yields following herbicide treatments were generally equal to those of cultivated control plots, and storage and eating qualities of roots were not impaired. Further studies are needed to ascertain the safety of DCPA as a post-transplanting treatment to slips and the safety of all the herbicides to vine cuttings.

Coastal Plain Expt. Sta., Tifton, Ga. 31794

Costs and Returns

See Also 28, 30, 36, 37, 40, 244, 255, 259, 271, 284, 307, 319.

288. Michalson, E. L. MACHINERY COSTS AND PERFORMANCE DATA FOR WHEAT-PEA FARMS IN THE PALOUSE ANNUAL CROPPING REGION. Wash. Agr. Expt. Sta., C. 437, 8 pp. 1964.

The data presented were designed as a quick reference for farm planners, farmers, and researchers. The data indicate typical performance rates, speeds, field efficiencies, man-hours per acre, and operating costs for new farm machinery. The types and sizes of farm machines included are those commonly used or being purchased to replace older machinery throughout the Palouse wheat-pea farming region. An average performance rate was indicated for each implement.

The range of machinery sizes selected as relevant was obtained from discussions held with farmers, machinery dealers, county agents, and agricultural engineers in the area. The variability of farm machinery sizes should be large enough to allow the application of these data to all topographical cropland situations found in the Palouse annual cropping region. The speed and field efficiency indicated for optimal operation of farm machines were adjusted to the type and horsepower of tractors used in this area.

The cost data are representative of those obtained from machinery dealers and suppliers in the area.

The data shown are offered only as averages to be used as guides for farm planning.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash. 99163

289. Schaffner, L. W., Loftsgard, L. D., and Owens, W. W. ECONOMICS OF LEASING FARM MACHINERY AND BUILDINGS. N. Dak. Agr. Expt. Sta. B. 450, 20 pp. 1964.

The leasing of farm machinery, buildings, and equipment is rapidly expanding.

Most machinery leasing in North Dakota is on a short-term basis, less than a year. The machine is leased on a day, hour, per acre or seasonal basis. Buildings, equipment, and some machinery are leased on a long-term type of lease, which is 3 to 5 years for equipment and machinery and 7 years for buildings.

For short-term leases, if the annual leasing rate under the short-term lease is not over 20 percent of the new cost of the machine, it may be cheaper to lease than to own the machine. The annual fixed costs of ownership using a fast depreciation rate may vary between 15 to 20 percent of new cost of the machine.

The lessee using the short-term type of lease is generally responsible for: (1) Picking up and returning the machine to the lessor; (2) maintaining the machine; (3) fuel, grease, and oil; (4) repairs due to negligent use of the machine; and (5) in some cases, insurance. If the lease is a long-term type, the lessee generally is responsible for: (1) Maintenance; (2) repairs; (3) fuel, grease, and oil; (4) insurance; and (5) housing.

There are many important factors to consider when making decisions to lease. The relative importance of these factors varies from one farm to the next. These include: (1) The opportunity rate of investment; (2) flow or release of capital over the period of analysis (important in long-term leases); (3) the depreciation rate; (4) the income tax rate; and (5) timeliness of operations.

A major consideration in leasing is that it releases capital tied up in ownership for use in other enterprises on the farm. Also, if lease payments are classified as a farm expense, leasing results in a larger tax saving than ownership.

The types of buildings known to be leased in North Dakota include silos, hog, and grain storage buildings. These usually are 7 year leases. The lessee is responsible for: (1) Maintenance; (2) repairs; (3) insurance; and (4) taxes during the lease period. Most long-term leases are handled by leasing companies outside the state that work with the local dealer.

Tables and graphs.

Agr. Expt. Sta., N. Dak. State U., Fargo, N. Dak. 58103

290. Helfinstein, R. D. ECONOMIC COMPARISON OF IRRIGATED AND DRYLAND FARMING IN CENTRAL SOUTH DAKOTA. S. Dak. Agr. Expt. Sta. B. 518, 67 pp. 1964.

The profitability of irrigation farming was compared with dryland farming for the proposed Oahe irrigation area of central South Dakota. The problems likely to arise when irrigation was introduced and any additional factors farmers needed to consider in deciding whether or not they wanted irrigation were considered.

Budgetary comparisons were made of irrigated and dryland farming for three typical sizes of farms in the Lake Plains area (Brown and Spink Counties) and for two typical sizes of ranches in the Missouri Slope area (Sully County). Input-output data were obtained from a personal interview survey of a sample of farm operators in the area and from estimates by research workers in technical fields of the South Dakota Agricultural Experiment Station. Current prices and costs, adjusted for expected trends to about 1975, were assumed.

Irrigation farms were assumed to be integrated dryland-irrigation farms with 56 percent irrigated land in Lake Plains and 42 percent in the Missouri Slope. These are the proportions classified as irrigable by the Bureau of Reclamation. Also, irrigable land is interspersed with dryland throughout the two areas.

A livestock organization that included a beef cow herd to consume native pasture with hogs and additional purchased beef feeder cattle to use the feed grains produced turned out most profitable under both dryland and irrigated conditions in the analysis. Illustrative of the financial results of the budgetary comparison are labor and management incomes from the 480-acre farms in Lake Plains: \$5,843 from the dryland and \$14,922 from the integrated dryland-irrigation farm. However, total investment on the irrigated farm was nearly double that on the dryland farm; \$123,651 compared with \$66,825. Total labor requirements also were nearly double: 357 man-days compared with 182.

The study emphasized that perhaps the most important factor favoring irrigation comes from stabilizing or leveling out high and low income and production periods.

Tables, charts, maps, and photographs.

Agr. Expt. Sta., S. Dak. State U., Brookings, S. Dak. 57007

291. Heady, E. O., Jacobson, N. L., Madden, J. P., and Freeman, A. E. MILK PRODUCTION FUNCTIONS IN RELATION TO FEED INPUTS, COW CHARACTERISTICS AND ENVIRONMENTAL CONDITIONS. Iowa Agr. Expt. Sta. Res. B. 529: 174-203. 1964.

Milk production functions as they relate to various levels and proportions of grain and hay in a ration restricted to these two feeds were studied. Auxiliary variables included: State of lactation; milk-producing ability; temperature; age; maturity; body weight; and a coefficient of inbreeding. These auxiliary variables were fixed at different levels to allow expression of milk production functions when the characteristics of cows are set at different magnitudes.

A total of 450 regressions was computed in estimating milk production functions in relation to feed inputs and auxiliary variables. The main regression equation selected for the analysis was a quadratic form with 26 terms, based on weekly observations of feed input and milk output for 72 lactations of Holstein cows. In this regression equation, 21 of the regression coefficients were significant at the 0.01 level of probability, five at the 0.05 level of probability, and one at the 0.10 level of probability. The value of R^2 was 0.836.

The isoquants and isoclines computed showed the substitution of grain and forage to be at diminishing marginal rates. Consequently, the optimum ration varied with the prices of the two types of feed. Since the isoclines derived were not linear through the origin of the feed plane, the optimum ration also changed as the price of milk increased or decreased and as feed prices were constantly relative to each other. Selected cow characteristics also were predicted to substitute for feed and for each other at diminishing marginal rates in attaining a given level of milk production.

Agr. and Home Econ. Expt. Sta., Iowa State U. Sci. and Tech., Ames, Iowa 50010

292. Sundquist, W. B., and Holt, J. INCOME-IMPROVING ADJUSTMENT ALTERNATIVES ON GRADE A DAIRY FARMS IN MINNESOTA. Minn. Agr. Expt. Sta., Sta. B. 473, 28 pp. 1964.

Many of the most profitable farm plans for both typical Grade A dairy farms include capital inputs and livestock enterprises much larger than those now typically found in southern Minnesota.

Many farm operators hesitate to use large amounts of credit because of risk. Another consideration is the value placed on having some leisure time (at least 1 day of the week).

Increasing farm size by adding cropland acreage is a profitable adjustment alternative for many farmers. The income potential of the 200 crop acre farm is much larger than for the 92 crop acre farm. Also, adding more cropland to the 200 acre farm increases its income potential considerably. Many farm operators have little or no opportunity to expand cropland acreage. In these cases, expansion of livestock enterprises is a particularly important adjustment alternative. Often, livestock feeding enterprises need not be limited to the size than can be finished with homegrown feed supplies.

To avoid more serious surpluses of milk than already exist, increased production from specialized dairy farms needs to be offset by reduced production on some farms. The number of Minnesota farms with some dairy cows is declining at a rapid rate. Continuation of this development will permit some increased specialization on remaining dairy farms.

U. Minn., Agr. Expt. Sta., St. Paul, Minn. 55101

293. Beaty, E. R., Worley, E. E., and Hayes, D. D. COASTAL BERMUDA-GRASS PELLETS, SUPPLEMENTED AND UNSUPPLEMENTED, AND WHOLE-GRAIN PELLETS FOR GROWING BEEF HEIFERS. J. Range Mangt. 18(1): 37-39. 1965.

In an experiment, 40 Angus heifers in duplicate lots of 5 animals each were fed one of 4 rations. Three experimental rations were composed primarily of forages. The check ration was ground-snapped corn and cottonseed meal.

No significant differences in daily gains were obtained between treatments. Heifers fed pelleted bermudagrass produced weight gains 94 percent of those on ground-snapped corn and adding 260 pounds of cotton seed per ton increased animal gains to 97 percent of those on the control ration. Pelleted drought-damaged whole-stalk corn produced animal gains equal to 87 percent of the control group. All rations were consumed similarly.

Branch Expt. Sta., Athens, Ga. 30601

294. Melton, A. A., and Riggs, J. K. FREQUENCY OF FEEDING PROTEIN SUPPLEMENT TO RANGE CATTLE. Tex. Agr. Expt. Sta. B. B-1025, 8 pp. 1964.

Three groups of wintering Hereford heifers and cows were supplementally fed cottonseed cake on pasture in the Davis Mountain area of Texas during four winters, 1958-62. The accompanying feeding schedules were used: (1) Two pounds per head daily the first year and 3 pounds daily the last 3 years; (2) seven pounds per head on Tuesdays and Saturdays during the first year and 10.5 pounds the last 3 years; and (3) four and two-thirds pounds per head on Tuesdays, Thursdays, and Saturdays the first year and 7 pounds the last 3 years.

The three groups were rotated among the pastures during the winter to minimize pasture differences as much as possible. All cattle were pastured together during the balance of the year.

Although slight but nonsignificant differences in weight changes were observed among the three groups of cows, the difference in frequency of feeding cottonseed cake had no significant effect upon percent calf crop weaned, weaning weight of calves, or weaned calf weight produced per cow. At the end of the fourth year, the females fed twice weekly showed slight advantage in weight and in percent calf crop weaned. They also tended to graze more widely over the pasture without waiting for supplemental feed than did those fed more frequently.

Feeding twice per week was as satisfactory as more frequent feeding and resulted in savings of approximately 60 percent in labor and travel as compared with daily feeding.

Tables, charts, and photographs.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843

295. Church, D. C., Snyder, F. R., and Smith, G. E. FEEDING VALUE OF SCREENINGS FROM ANNUAL RYEGRASS. Oreg. Agr. Expt. Sta. B. 597, 10 pp. 1964.

Screenings from annual ryegrass seed were evaluated by means of digestibility trials with sheep and in the laboratory by chemical analyses and digestion in an artificial rumen. Data obtained indicated that they had a variable feeding value, depending upon the amount in the ration and the nature of the other feedstuffs when fed in various combinations. Alfalfa, particularly, seemed to enhance the value of a combination of feedstuffs and screenings. Screenings such as those fed in Experiment I and the heavy screenings fed in Experiment II were quite digestible and had a feeding value similar to that of lightweight barley when fed alone or in combination with other feeds.

The lightweight screenings fed in Experiment II were quite bulky, high in fiber, and much lower in digestibility than the heavier screenings. On a comparative basis, such screenings as these would be worth about two-thirds the value of the alfalfa pellets or about one-half the value of the heavy screenings. Such a feedstuff would be suitable when included in small amounts (30 percent or less), along with other high-quality ingredients in a fattening ration as a means of reducing the feed cost because of their low selling price. For maximum performance, such lightweight screenings would not be recommended. Screenings of this quality would be more suitable when used in a wintering program along with other feeds normally available in the area.

It was difficult to assign an exact nutritive value to a feed such as ryegrass screenings, since the nutritive value was influenced by composition of the screenings, the amount fed, and by the other feedstuffs when fed in a mixture.

Tables.

Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg. 97331

296. Edgerly, C. G. M. BEET PULP SATISFACTORY FEED FOR DAIRY COWS. N. Dak. Farm Res. 32(7): 10-12. 1964.

The results indicated that dried molasses beet pulp can replace oats and barley in the grain mixture and approximately one-third of the hay when fed at the level of 3/4 pound of beet pulp per 100 pounds of body weight of the animal. Sufficient grain such as corn and some soybean oil meal was needed to supplement the beet pulp to provide the necessary energy and protein.

The trial also substantiated the earlier report that the oats and barley raised in this area have a higher feeding value than is generally considered for the country as a whole. Palatability of the dried molasses beet pulp rated high with the cows.

With hay at \$20.00 per ton, grain at \$40.00 per ton, and dried beet pulp at \$35.00 per ton, the cost of the beet pulp as used was only slightly higher than the costs of the feeds replaced by it. The savings of the 10 pounds of hay and 5 pounds of grain amounted to 20 cents per day while the cost of 12-1/2 pounds of beet pulp was about 21.8 cents. The handling of the pelleted dried beet pulp is more easily adapted to mechanization and could result in a saving of labor.

N. Dak. Agr. Expt. Sta., N. Dak. State U., Fargo, N. Dak. 58103

297. Hemstrom, M. L. BEET TOPS AS LIVESTOCK FEED. Idaho Ext. Serv., Idaho Current Inform. Ser. 1, 2 pp. 1964.

When the conversion of solar energy to plant food is considered, sugar beets are one of the most efficient crops grown. If the beet byproducts--including the beet pulp--from 1 acre of sugar beets are completely utilized as livestock feed, they will

exceed the feeding value of an acre of alfalfa or an acre of grain produced under the same conditions.

On the average, a 20-ton crop of beets supplied about 14 tons of tops per acre. This provided an average of 2-1/2 tons of dry matter, including 560 pounds of protein. Included in a balanced ration this produced more than 325 pounds of beef or lamb.

Field-cured beet tops had about 72 percent of the value of alfalfa hay. Dehydrated beet leaves and dehydrated beet tops were worth 15 percent and 8 percent more respectively on a total digestible nutrient basis than alfalfa.

Beet top harvesters, which removed the tops from the root before digging, were the most effective means of saving the tops. The tops were elevated into trucks and then hauled to pits, stacks, or silos. Crib-type silos on good drainage had an advantage over pits and concrete bottom bunker silos because of the seepage factor. Ensiling was usually recognized as the best method of handling beet tops.

Rapid moisture and carotene losses occurred the first 10 days after tops were cut if they were windrowed or field stacked. Much of this loss could be prevented by field chopping and ensiling the tops. When ensiling fresh tops, it was good practice to add a low moisture forage crop such as straw or hay or concentrates to help absorb the juices. Beet tops were a highly laxative feed when used as the only source of roughage. They should be fed with another dry roughage or with grain. Cattle pasturing beet tops should have access to dry pasture or be fed straw.

Agr. Ext. Serv., Agr. Expt. Sta., Col. Agr., U. Idaho, Moscow, Idaho 83843

298. Johnson, S. R., and Tefertiller, K. R. ESTIMATING THE INFLUENCE OF DIVERSIFICATION ON FARM INCOME VARIABILITY DRYLAND ROW-CROP FARMS--HIGH PLAINS OF TEXAS. Tex. Agr. Expt. Sta., MP-751, 14 pp. 1964.

Assuming that dryland row-crop farmers in the High Plains of Texas are interested in two general objectives in regard to their farm operations--income maximization and income stability--this analysis is significant for decision-makers both at firm and at policy levels. The analysis shows that the two goals are complementary as cotton is substituted for grain sorghum up to 44 percent of the total cropland acreage. It also shows that cotton could be profitably substituted for grain sorghum up to 60 percent of the total cropland acreage with a relatively small loss in income stability.

These results are of particular importance since they are relatively insensitive to price changes. These conclusions were based on cotton priced at \$30.00 per hundredweight and grain sorghum at \$1.50 per hundredweight, however, a 3-percent interval on either side of the minimum variation solution for these prices would include all of the possible solutions of this analysis for grain sorghum prices varying from \$1.30 to \$1.70 per hundredweight and cotton prices varying from \$25.00 to \$35.00 per hundredweight. Cotton allotments are an institutional restriction in the High Plains and have varied from 20 to 40 percent during the past several years for most dryland farms. When the cotton allotment was considered in connection with the above results, it was possible to conclude that dryland row-crop farmers were maximizing both income and stability if they used their entire cotton allotment. The analysis also indicated that, if government supply control policies for cotton and grain sorghum were eliminated and if High Plains dryland farmers had a slightly higher preference for income maximization than for income stability, there would be pronounced increases in the acreage of cotton grown in the area.

Tables and charts.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843

299. Barnhill, H. E. RESOURCE REQUIREMENTS ON FARMS FOR SPECIFIED OPERATOR INCOMES. U.S. Dept. Agr., Econ. Res. Serv., Farm Prod. Econ. Div., Agr. Econ. Rpt. No. 5, 55 pp. 1964.

The minimum complement of resources needed to enable farm operators of major types of farms to achieve specified levels of earnings for their labor and management was determined. Major types of farms were budgeted for 4 levels of operator earnings in 29 selected areas. The levels of operator earnings were \$2,500, \$3,500, \$4,500, and \$5,500. Resources were assumed to be available to the operator in any amount

needed at assumed prices. The budgets describe resource requirements for efficiently organized farms on which full use is made of improved practices and available technology. Major findings of the study were:

1. The amount of gross sales required on the 29 farms budgeted for operator labor and management earnings of \$2,500 a year ranged from \$6,750 to \$26,450. For earnings of \$3,500, the range was \$9,340 to \$36,960. And, for earnings of \$4,500 and \$5,500, the range was from \$11,700 to \$49,230 and \$14,990 to \$62,100, respectively.
2. The amount of investment capital in land, buildings, livestock, and equipment exceeded \$100,000 on 8 of the farms budgeted for \$5,500. At the lowest level of operator earnings (\$2,500) such investments exceeded \$50,000 on 12 of the 29 budgeted farms.
3. Investment capital costs on the budgeted farms were calculated at 5 percent per year. At this rate, returns to capital were frequently greater than returns to operator labor and management.
4. Labor used on the budgeted farms varied widely. For the highest level of earnings (\$5,500), the amount of operator and hired labor used ranged from 591 to 9,229 man-hours. The average was 3,552 man-hours--about 1-2/5 man-years.
5. Within the range of operator earnings considered, it was found that resources generally were used more efficiently as the level of operator earnings increased. The greatest gain in efficiency was obtained in moving from \$2,500 to \$3,500 operator earnings.
6. A decline in prices or an increase in costs generates a drive for farm enlargement.
7. In only 9 of the 29 areas studied was the majority of farms large enough to produce \$2,500 operator earnings. In only 1 area was the majority large enough to provide \$5,500 operator earnings.
8. These findings suggest that farm enlargement and consolidation will continue.

Tables and charts.

OMS, USDA, Inform. Div., Washington, D.C. 20250

300. Givan, W., and Parry, S. CHARACTERISTICS, EXPANSION PLANS, AND PROJECTIONS FOR THE TENNESSEE GRADE A MILK INDUSTRY. Tenn. Agr. Expt. Sta. B. 382, 32 pp. 1964.

The amount of milk sold as Grade A under Federal order has increased since 1958, yet has been produced by a continually decreasing number of producers.

In the spring of 1963, there were 3,097 producers in Tennessee selling milk under Federal orders. This accounted for approximately 88 percent of all Grade A milk sold in the State. The average Grade A producer responding to the mail questionnaire was 47 years old, had farmed about 250 acres of land, and had 41 mature cows in his herd, with each cow producing an average of 7,157 pounds of milk annually.

The largest size farms and herds were found in the Memphis milkshed,* while the smallest ones were found in the Knoxville milkshed.

Eighty-six percent of the producers worked less than 50 days per year off the farm, but slightly over three-fourths of all producers had a source of farm income in addition to dairying. Slightly over one-half of the producers raised all of their replacement heifers, while 6 percent bought all of their replacements. Sixty-two percent of all producers owned all of their land. Seventy percent of all producers raised all of their hay, while nearly one-half of the producers bought all of their grains.

Artificial insemination for all cows was used on about one-third of the farms. Almost one-third of the herds used no artificial insemination.

There has been a definite trend in recent years for Grade A producers to increase the size of their operation due to economic and technological changes.

Nearly two-thirds of all producers felt that they had available capacity for further expansion. Fifty-five percent of the respondents planned to expand their size of operation by 1965.

An increase in economic pressures is expected to make survival in the industry more difficult for the smaller producers, thus forcing them to expand or drop out.

Table and charts.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn. 37901

Institutional, Educational, and Social Factors

Affecting Conservation Application

See Also 4, 38, 255, 271, 320, 338, 340, 341, 342, 348.

301. Bird, A. R. ECONOMIC GROWTH OF RURAL AREAS--PROBLEMS AND OPPORTUNITIES. Agr. Econ. Seminar, U. Del., Nov. 19, 1964.

A definition of economic growth based on the Economic Opportunity Act of 1964 was cited. Economic growth means economic and social development of a local area to attain certain minimum family income standards and strengthen local government. The census definition of rural was used. The present extent of rural poverty was sketched. In 1959, about 17.4 million rural people were living in poverty. This was about half the poor in the Nation. For every 6 who lived on farms, there were 10 other poor people who lived in rural areas. Implied programs needed to promote economic growth of rural areas were suggested.

RDED, ERS, USDA, Washington, D.C. 20250

302. Anonymous. FARM DEBT: DATA FROM THE 1960 SAMPLE SURVEY OF AGRICULTURE. Board of Governors of the Federal Reserve System. Unnumbered Rpt., 36 pp. text plus 185 pp. tables. \$1.00. 1964.

In the 1960 Sample Survey of Agriculture, the Bureau of the Census made its first comprehensive inquiry into the use of credit by farmers. It asked operators and landlords on a national sample of farms to report the farm debts owed to specified creditor groups.

The 1960 Sample Survey of Agriculture and a related survey of debts of farm landlords provided recent data that added significantly to the knowledge of some key aspects of farm credit. For each farm in the sample, the Survey obtained information on the amount and sources of debt and also on many other facets of the farm operation. As a result, data became available not only on the distribution of farm debt by creditor groups but also on the distribution of debt among farms grouped by size, type, age of operator, and other characteristics of the farm or farm operator. Ratios of farm debt to sales, to net income, and to value of land and buildings for various categories of farms could also be calculated.

This handbook provides information for a variety of uses, including investigations into the indebtedness of particular groups of farmers and analyses of the relationships among indebtedness and other surveyed characteristics of the farms and farm operators. Both debt and other data related to farms were presented for a large number of classifications and cross-classifications of farms and farm operators. The credit data for these various groups and distributions of farms should be more meaningful by presenting data on the farmers' ages, sales, incomes, and other items to which the debt is often related.

The data presented were estimates based on a sample of farms, and was subject to sampling and reporting errors.

For sale by Board of Governors, Federal Reserve Systems, Washington, D.C. 20551

303. Wadleigh, C. H. COMING TO TERMS WITH NATURE. J. Soil and Water Conserv. 20(2): 43-45. 1965.

A discussion was given on coming to terms with nature.

The author concluded that learning the secrets of natural phenomena and then developing chemical, physical, biological, and engineering ways and means to aid and

abet man's dominance over nature were truly among the greatest attainments of civilized societies.

SWCRD, ARS, USDA, Beltsville, Md. 20705

304. Solberg, E. D. MASTER PLANNING FOR RESOURCE DEVELOPMENT. Soil Conserv. Dist. Outlook Commn., Arlington, Va. Aug. 18, 1964.

All 50 of our States have passed enabling laws that authorize all or selected counties, or towns or townships to zone unincorporated or rural areas in nearly three-fourths of the 3,000 counties in the United States. Eight States, including Hawaii, have made a beginning with zoning at the State level. More than 400 counties and nearly 1,700 towns or townships have adopted zoning ordinances. Exclusive-type farm zoning districts for the protection of agriculture have been established in California and in nearly a dozen other States.

Zoning districts in the open country attain a variety of objectives. Forestry districts foster and protect forest resources; recreation districts protect summer homes, and areas with scenic, water, or historic attractions. Hawaii placed its forest and water reserve lands in conservation zones. Other watershed zoning districts protect water production lands from fire, erosion, soil compaction, and pollution of scenic attractions. Floodway and flood plain zoning regulations prevent obstruction of flood flows and minimize flood damages.

RDED, ERS, USDA, Washington, D. C. 20250

305. Baum, E. L., and Spiegelman, R. G. TWO SUGGESTED CRITICAL TOPICS FOR RESEARCH IN REGIONAL DEVELOPMENT IN THE UNITED STATES. Conf. Res. Strategy Regional Develop., Ames, Iowa, Oct. 14, 1964.

The problems and suggested research to develop the relevant considerations and analytical techniques for identifying and delineating areas and subareas that have reasonable prospects for economic development were discussed. Planning economic growth in small areas, including the evaluation of the impact of programs and policies for small area development and local government services was studied.

The discussion emphasized the important aspect of development planning which takes the internal structure of the area into account and the need to plan for the proper interrelations of its subareas. Subarea planning permits a balancing of needs and potentials on a small area basis, so that proper consideration can be given to possibilities of short distance labor migration to correct imbalances in the employment structure. A discussion was given on the needs to improve our techniques for measuring the extent of underemployment in small areas.

Since small area development is a relatively new field of research, there is a lack of proven methodology to allow planners to determine whether or not a small-area economy is viable, whether the selected area has sufficient size and resource base to accomplish the needed development. In line with such needs, suggested analytical methods and procedures (planning models) were presented that, with adaptations to varying sets of local conditions, will be suitable for appraising the overall potentials of additional industrial, commercial, and other forms of public and private investments in such areas. Such a planning model can give direction to detailed followup studies required for the formulation of a specific comprehensive area economic program. A short discussion on the need to develop precise research tools aid in selecting industry activities suitable for development in rural areas was included.

RDED, ERS, USDA, Washington, D.C. 20250

306. Southern, J. H. REGIONAL GROWTH AND DEVELOPMENT AND RURAL AREAS. Agr. Outlook Conf., Washington, D.C., Nov. 17, 1964.

Regional and area growth were considered in terms of employment and job opportunities. Four forces that are governing the pattern of employment development for rural people were discussed. These were: (1) A continuous decline in use of manpower in agriculture; (2) a high replacement ratio in rural populations; (3) concentration of employment in certain regions and localities and public sector activities; and (4) investments tending toward further concentration of opportunities.

Employment and economic opportunities in the total labor force are becoming highly concentrated in Standard Metropolitan Areas. These areas more than accounted for the total employment growth during the 1950's, increasing their employment by 33 percent. At the other extreme, all centers with less than 5,000 population had a decline in employment of 22 percent. Public-sector spending was tending to further concentrate employment and opportunity with specific localities receiving the greatest benefits.

The outlook for changing this pattern of growth is not bright unless specific policies are effected to expand other potential growth centers.

RDED, ERS, USDA, Washington, D.C. 20250

Soil Conserv. 30(1): 1-24. 1964.

This issue of Soil Conservation was devoted mostly to new areas in conservation. The following articles were given:

307. Graham, E. H. SCS GOES ABROAD: NEW TYPE OF CONTRACT WITH AID SENDS TECHNICIANS TO FOREIGN LANDS UNDER SCS SUPERVISION. SCS, USDA, Washington, D.C. 20250
308. Hafenrichter, A. L. NEW CONSERVATION PLANTS IN THE WEST: SUPERIOR VARIETIES AND NEW METHODS INCREASE FARM AND RANCH INCOME. SCS, USDA, Portland, Oreg.
309. Anonymous, MUD RIVER WATERSHED: AWARD-WINNING PROJECT GIVES KENTUCKY TOWNS WATER SUPPLY, RECREATION, INDUSTRY.
310. Anonymous. NEW HOPE FOR SUNSET COMMUNITY: RURAL PEOPLE, AGENCIES WORK TOGETHER TO DEVELOP RESOURCES.
311. Rush, R. W., and Brown, W. F. AGENCIES, LANDOWNERS JOIN EFFORTS TO IMPROVE DITCH. SCS, USDA, Chillicothe, Ohio. 45601
312. Fisher, J. R. LARGE FLOODWAYS PRESENT PROBLEMS IN CONSTRUCTION. SCS, USDA, Montevideo, Minn. 56265
313. Anonymous. CAMP CONSERVATION WINS SCOUT COUNCIL AWARD.
314. Dompier, L. FARM POND SERVES FIRE PROTECTION AND RECREATION. SCS, USDA, Davenport, Wash. 99122
315. Anonymous. FRANCIS E. COXE: SOUTH CAROLINA CONSERVATION MAN OF THE YEAR.
316. Williams, D. A. THE NEW TECHNICAL SERVICE CENTERS. SCS, USDA, Washington, D.C. 20250
317. Tharp, M. M. MOBILITY AND OUTDOOR RECREATION. Middle Atlantic Div. Assoc. Amer. Geographers, Washington, D.C., Jan. 30, 1965.

America has become a Nation on wheels. Nearly 85 million automobiles, trucks, and buses now cruise our highways and streets. This increased mobility is having a profound effect on the demand for outdoor recreation. Available time for recreation, rather than distance, influences use of recreation areas. A carefully planned recreation program well-integrated with the interstate and other Federal-aid highway systems could satisfy the rising recreation demands. Both mobility and recreation can be provided when both activities are balanced to take advantage of access and recreation opportunities. Proper planning and management of recreation areas for specific uses, integrated with the highway systems, would give a constructive purpose to our restless mobility.

RDED, ERS, USDA, Washington, D.C. 20250

318. Landstrom, K. S. OUTDOOR RECREATION IN THE FUTURE OF PUBLIC LANDS. J. Range Mangt. 18(2): 66-69. 1965.

Range management's goal of increased profits from livestock production should be viewed within a broader context in which the professions dealing with natural resources try to bring about the greatest good for the greatest number of people. Range forage production from public lands can be maintained or increased under a well-rounded resource conservation program despite land-use restrictions for outdoor recreation.

U.S. Dept. Int., Washington, D.C. 20240

319. McCurdy, D. R. MAKING WOODLAND RECREATION PAY. Proc. Soc. Amer. Foresters, Denver, Colo. 156-158. 1964.

Seventy-two forest recreation enterprises receiving one-fourth or more of their income from picnickers were studied in Ohio. Sixty-seven of these provided additional facilities for one or more of the following outdoor activities: Swimming; fishing; horseback riding; and camping. Many also sold soft drinks, candy, and recreation supplies. Size of the developed recreation areas ranged from 3 to 500 acres. Seventy-five percent of the enterprises were located within 30 miles of cities larger than 75,000 inhabitants.

Enterprise investment ranged from \$3,000 to \$450,000 with a median investment of \$50,000. Cost of land was generally the largest single capital investment (median cost \$9,000). Areas already having a lake, pond, or stream required smaller initial outlays. Median investments of \$1,000 to \$5,000 were usually required for each of the following: Land improvements; roads; buildings; equipment; and sanitation facilities.

Most incomes have not met owner expectations. Income from one-third of the private-forest picnic enterprises studied in Ohio was not enough to cover all annual operating expenses (both fixed and variable). An even larger number of enterprises were not able to compensate the owner for his labor, management, and interest on investment. The incomes ranged from \$28,500 to a deficit of \$5,200 with a median of \$720. Seventy-five percent of the enterprises had incomes less than \$5,000.

The opportunity for a woodland owner to make recreation pay was governed to a great extent by his aptitudes, interests, and skills. Other items were cost, quantity, and quality of local labor supply, local laws and regulations, existence of other recreational areas nearby, availability of low-cost capital, neatness of recreation area, and cost of insurance.

The woodland picnic businesses in Ohio with the greatest income were near large metropolitan areas and located in counties with relatively large total personal incomes, had a sufficient variety of services and outdoor facilities to attract large crowds, provided swimming facilities, and advertised widely.

North Central Expt. Sta., FS, USDA, St. Paul Campus, U. Minn., St. Paul, Minn. 55101

BIOLOGY

Fish

See Also 319, 350.

320. Byrd, I. B., and Crance, J. H. FOURTEEN YEARS OF MANAGEMENT AND FISHING SUCCESS IN ALABAMA'S STATE-OWNED PUBLIC FISHING LAKES. Trans. Amer. Fisheries Soc. 94(2): 129-134. 1965.

Twenty state-owned lakes containing 1,733 acres were opened to public fishing for 1 to 14 years during the period of 1950 to 1964 and provided a total of 13,695 acre-years of fishing. During this 14-year period, a total of 1,844,397 fisherman caught 7,855,325 fish weighing 2,375,788 pounds, which included 413,876 largemouth bass (*Micropterus salmoides*) weighing 395,222 pounds. These lakes, therefore, provided per acre an annual average of 135 fisherman-trips and a catch of 573 fish weighing 173 pounds, including 30 largemouth bass weighing 29 pounds.

The highest average catch of 224 pounds per acre occurred during the first year of fishing following opening. The average catch per acre during each of the following 13 years ranged from 151 pounds during the third year to 202 pounds for the fourteenth year.

Approximately 7,380,000 visitors, in addition to fisherman, used the lake areas for picnicking, hiking, camping, swimming, and boating.

Revenues received from the sale of fishing permits and boat rental fees were adequate to cover costs of management, operation, and maintenance. Management consisted of fertilization, partial poisoning with rotenone, restocking of fingerling largemouth bass, and annual spraying of 2,4-D to control marginal vegetation.

Ala. Dept. Conserv., Div. Game & Fish, Montgomery, Ala. 36830

321. Seaburg, K. G. and Moyle, J. B. FEEDING HABITS, DIGESTIVE RATES, AND GROWTH OF SOME MINNESOTA WARMWATER FISHES. Trans. Amer. Fisheries Soc. 93(3): 269-285. 1964.

Quality and quantity of food ingested, summer feeding habits, and digestion rates were reported for eight species of fish from two western Minnesota lakes, one of which had a dense population of centrarchid panfishes and the other, a smaller population. Both lakes also had game and forage fishes.

Fish were taken by seining from weedy littoral areas and stomach contents removed with a stomach pump. Quality and quantity of stomach contents were related to kinds and sizes of fish, growth, population density, and inter- and intra-specific competition.

Greatest volumes of food were found in the stomachs in early summer and least in late summer. The three centrarchid panfishes fed mostly on insects in early summer but as summer progressed bluegills ingested more plant material, pumpkinseeds more snails, and crappies more fish. Crustaceans were important only in early and late summer and were most important for small fish. Centrarchid panfishes had fewer empty stomachs (6.4 percent) than the gamefishes (40.7 percent). Bluegills fed fairly regularly throughout the day. Northern pike, walleyes, and bass fed mostly on perch even when minnows and small centrarchid panfishes were common. However, the crappie diet included small centrarchids as did that of bluegills from the denser population.

Digestive rates were faster for centrarchid panfishes than for the larger game fishes. At water temperatures mostly between 64° and 74° F., the panfishes digested about 50 percent of stomach volumes in 5 hours, 75 percent in 12 hours, and nearly 100 percent in about 21 hours. Northern pike required about 20 hours for 50 percent reduction of stomach contents and 50 hours for 100 percent.

The average daily ration for the summer for the centrarchid panfishes was usually between 1 and 2 percent of the body weight.

Minn. Dept. Conser., Div. Game and Fish, St. Paul, Minn. 55101

322. Eipper, A. W. GROWTH MORTALITY RATES, AND STANDING CROPS OF TROUT IN NEW YORK FARM PONDS. N.Y. State Col. Agr. Memoir 388, 67 pp. 1964.

Studies were conducted from 1952-58 to determine the reproduction, growth, natural mortality, fishing potential, and standing crops of trout in 70 central New York farm ponds which had surface areas of 0.1 to 1.8 acres and maximum depths of 5 to 14 feet. Approximately one-half of the ponds had some degree of permanent spring water supply.

The usual experimental approach was to stock trout as spring fingerlings (age 0) or fall fingerlings (age 0) in series of ponds at stocking rates varying from 200 to 800 per acre, and to determine survival and growth in each pond in successive half or whole years by spring and/or fall population inventories.

Of the 195 pond inventories from which usable data were obtained in the 7-year study, brook trout was the single or dominant species in 141, rainbow trout in 46, and brook X brown trout hybrids in 8. Fragmentary data on brook X lake trout hybrids and a wild strain of brook trout were also available.

Survival of brook X brown trout hybrids from fertilized egg to free-swimming fry was approximately 17 percent. Brook X lake trout hybrids showed about 75 percent survival from egg to fry. Wild and domestic brook trout did not differ appreciably in survival or growth in 3-year tests.

Nearly all farm ponds lacked suitable environmental conditions for successful trout reproduction, although brook trout frequently spawned.

Growth of a given trout pond population in a given time interval was measured by increment in mean length, increment in mean weight, and the coefficient of growth in mean weight ("instantaneous growth rate"). Weight increment was a better measure of growth than length increment or growth coefficient.

There were no differences in natural mortality rate (n) between brook, rainbow, or brook X brown hybrid trout of comparable ages.

Cornell U., Agr. Expt. Sta., N.Y. Col. Agr., Ithaca, N.Y. 14850

323. Croker, R. A., and Wilson, A. J. KINETICS AND EFFECTS OF DDT IN A TIDAL MARSH DITCH. Trans. Amer. Fisheries Soc. 94(2): 152-159. 1965.

A tidal marsh ditch near Pensacola, Fla., was treated with 0.2 pound of DDT per acre in March 1963 and observed for 4 months. Ninety-eight percent of the animal mortality occurred within 3 weeks after treatment. A population of cyprinodont fish was restored by reproduction of surviving and introduced fish. DDT was detected in surface water samples 8 days after treatment but not after 14 days, while DDT was not detected in bottom-water samples later than 1 day after treatment. Seven weeks after treatment, vegetation samples averaged 9.1 p.p.m. of DDT, after reaching a maximum of 75 p.p.m. of DDT 3 to 4 weeks after treatment. Sediment samples yielded more variable residues, averaging 0.76 p.p.m. of DDT at 7 weeks after reaching a maximum of 3.35 p.p.m. of DDT 6 weeks after treatment.

Fish accumulated up to 90 p.p.m. of DDT within 5 weeks after treatment. Highest DDT residues detected in fiddler crabs and snails ranged from 15 to 25 percent of the average residues detected in fish. The net water movement as indicated by the distribution of Rhodamine B dye, the general distribution of DDT residues in all samples, and the difference in mortality of fish at two holding sites, indicated an accumulation of DDT in the lower marsh after treatment.

U.S. Bur. Comm., Fisheries, Biol. Lab., Gulf Breeze, Fla. 32561

324. Allison, D. T., Kallman, B. J., Cope, O. B., and Van Valin, C. SOME CHRONIC EFFECTS OF DDT ON CUTTHROAT TROUT. U.S. Dept. Int., Bur. Sport Fisheries and Wildlife Res. Rpt 64, 30 pp. 1964.

Effects on cutthroat trout (Salmo clarki lewisi) of periodic exposure to different levels of DDT in water and in food were determined over a 20-month period involving one spawning cycle. High dosages produced a marked increase in mortality, probably by reducing resistance to nonspecific stressors; surviving fish in high-dosage lots were significantly larger than those in control and low-DDT lots. This effect occurred with no change in growth rate.

The number and volume of eggs produced was not reduced by DDT, but mortality among sac-fry appeared to be highest in the high-dosage lots. The reproductive potential of fish treated at high levels was reduced by high rates of mortality among adults and in sac-fry from survivors.

Intermediate and low dosages of DDT generally did not measurably affect mortality, growth, or reproductive potential, indicating that a threshold level exists around 0.1 p.p.m. monthly in contact form and around 0.3 mg. DDT per kg. of fish weekly in the diet for the toxic effects of DDT.

Metabolic conversion of DDT to DDE occurred to a greater relative extent in fish exposed to low dosages; at these levels, total residues of chlorinated hydrocarbon were not higher than in controls. Residues of DDE were present in most of the fish, possibly as a metabolite of DDT. These data suggest that the usual control treatment exposures to sublethal levels of DDT are unlikely to damage a population of rainbow trout.

Bur. Sport Fisheries and Wildlife, U.S. Dept. Int., Washington, D.C. 20240

325. Eisler, R. SOME EFFECTS OF A SYNTHETIC DETERGENT ON ESTUARINE FISHES. Trans. Amer. Fisheries Soc. 94(1): 26-31. 1965.

Acute toxicity of an alkyl benzene sulfonate (ABS) surfactant detergent to five species of juvenile estuarine fishes was determined at 20 percent salinity and 20° C. Concentrations of detergent that will kill 50 percent of the test organisms in 96 hours ranged from 7.0 p.p.m. for silversides (Menidia menidia) to 22.5 p.p.m. for mummichogs, Fundulus heteroclitus. Intermediate in susceptibility were mullet, Mugil cephalus (10.1 p.p.m.), winter flounder, Pseudopleuronectes americanus (8.2 p.p.m.), and eels, Anguilla rostrata (7.5 p.p.m.). After 12 weeks in solution, the synthetic detergent (syndet) retained most of its toxicity. The stock syndet contained 30.3 percent ABS as weak zero as determined by the methylene blue method.

Salinity of the medium affects toxicity of the syndet. Eels exposed to 10 p.p.m. syndet for 96 hours and mummichogs exposed to 20 p.p.m. syndet for 120 hours were relatively unaffected at salinities below 15 percent but died at salinities approaching ocean strength.

Prolonged exposure of 150 days of juvenile mummichogs to syndet concentrations of 1, 2, 5, 8, or 10 p.p.m. at salinities of 10, 20, 30, or 40 percent, when compared to controls, did not significantly affect any biological variable measured (mortality, growth in length and weight, red blood cell number, gonadosomatic index, and liver condition).

U.S. Fish and Wildlife Serv., Sand Hook Marine Lab., Highlands, N.J. 07732

Upland Wildlife

See Also 255.

326. McMahan, C. A., and Ramsey, C. W. RESPONSE OF DEER AND LIVESTOCK TO CONTROLLED GRAZING IN CENTRAL TEXAS. J. Range Mangt. 18(1): 1-7. 1965.

White-tailed deer welfare and production under various intensities of continuous-use grazing by combined cattle, sheep, and angora goats were studied in the Edwards Plateau region of Texas. Under poor range conditions, continuous grazing by combined classes of livestock adversely effected deer production through competition for food. Livestock were more efficient competitors for native forage than deer.

Only a few of the more desirable livestock and deer food plants were able to grow and reproduce under the continuous-use system. These findings stress the importance of giving plants periodic rest periods so that they may reproduce.

Livestock production per animal, and the net return per animal unit, increased as the stocking rate decreased. The moderately-grazed pasture averaged the most returns per acre, followed in sequence by the heavy and lightly grazed pastures.

Tex. Parks and Wildlife Dept., Kerr Wildlife, Mangt. Area, Hunt, Tex. 78024

327. Zalunardo, R. A. THE SEASONAL DISTRIBUTION OF A MIGRATORY MULE DEER HERD. J. Wildlife Mangt. 29(2): 345-351. 1965.

Rocky Mountain mule deer (Odocoileus hemionus) were trapped, marked, and released on the Silver Lake winter range in south-central Oregon, and their subsequent movements were observed from June 1960 through October 1963 to determine ranging habits. A total of 752 deer were marked on four areas of the winter range, and an estimated 497 were later observed on the summer range. The summer range of marked animals encircled the winter range, except that no animals summered in areas northeast of the winter range because of lack of suitable habitat. The largest percentage of animals summered in areas south, southwest, and west, and within 30 miles of the winter range.

Deer from any one of the four trapping areas did not move to a particular part of the summer range but were found throughout the area. The average size of the summer range for individual mule deer of the Silver Lake herd was approximately 1 square mile. Individual movement on the winter range was determined by retrapping.

The mean movement of animals on the winter range was less than 1/4 mile from the point of original capture. Individual deer returned to the same area of the winter range each year.

Div. Wildlife Res., Oreg. State Game Comm., Corvallis, Oreg.

328. Anderson, A. E., Snyder, W. A., and Brown, G. W. STOMACH CONTENT ANALYSES RELATED TO CONDITION IN MULE DEER, GUADALUPE MOUNTAINS, NEW MEXICO. J. Wildlife Mangt. 29(2): 352-365. 1965.

An index to the food habits of a nonmigratory mule deer (Odocoileus hemionus) population occupying a juniper-pinyon woodland, succulent-shrub, and the shortgrass-shrub complex in southeastern New Mexico was provided by botanical analyses of 93 stomach content samples. Thirty-nine males and 54 females were obtained by shooting approximately 2 deer per month over a 49-month period. Of the total estimated volume of stomach contents, browse made up about 70 percent; forbs, 26; and grass and unidentified plant material the remainder. The five major food items, comprising about 64 percent of the total, were wavyleaf oak (Quercus undulata), juniper (Juniperus spp.), hairy cercocarpus (Cercocarpus breviflorus), yucca (Yucca spp.), and unidentified forbs, in order of decreasing percent volume. Juniper was the highest in total frequency with less variability and was the major item during the January-March period. Wavyleaf oak was the major item from April through December.

When unusually heavy precipitation increased all forage--especially forb production in 1958-59--forbs exceeded both browse and grass components yearlong. Females of all age-classes collected during and for several months after, this period were significantly heavier and presumably in better physical condition.

Game and Fish Res. Cent., Colo. Game, Fish & Parks Dept., Fort Collins, Colo.

329. Lay, D. W. FRUIT UTILIZATION BY DEER IN SOUTHERN FORESTS. J. Wildlife Mangt. 29(2): 370-375. 1965.

Examination of the woody seed content of 2,295 deer (Odocoileus virginianus) pellet groups, collected on four study areas in the forests of eastern Texas over a period of 7 years (1956-63), disclosed 69 identifications for 100 pellet groups. The most frequently identified species or genera were: Oaks (Quercus spp.); yaupon (Ilex vomitoria); American beautyberry (Callicarpa americana); black tupelo (Nyssa sylvatica); and hawthorn (Crataegus spp.). Inspection of the contents of 49 stomachs from one study area in 1963 revealed an oak species present in every stomach. Deer on ranges with a large variety of hardwoods of fruit-producing sizes consumed more fruit than did deer on ranges with fewer hardwoods, indicating that utilization was an obvious reciprocal of availability.

Tex. Park and Wildlife Dept., Buna, Tex. 77612

330. Dalke, P. D., Beeman, R. D., Kindel, F. J., Robel, R. J., and Williams, T. R. USE OF SALT BY ELK IN IDAHO. J. Wildlife Mangt. 29(2): 319-332. 1965.

The use of salt in the management of Rocky Mountain elk (Cervus canadensis nelsoni) in Idaho was investigated in 1955-60. Salt hunger developed in elk during May after they had been feeding on succulent forage for 2 to 3 weeks. The degree to which artificial salt grounds were used by elk depended chiefly on: Their location in respect to desired vegetation; elevation; number of migrant animals in the area; the existence of salt; and the amount of disturbance by livestock. Maximum desire for salt covered a period in late May and early June.

Artificial salt blocks were consumed before there was a noticeable use of the salt-impregnated soil. In the chemical analysis of spring water from 16 samples, sodium carried in the spring waters seemed to be the element attracting elk. The physical characteristics of water issuing from the licks appeared to have no relationship to its use. One hundred and ninety correlations were run on the computer of five elements, bicarbonate, and sulfate in both water and soil at the natural licks, along with total soluble salts, pH, and water temperatures. Nineteen correlations were highly significant, and eight were significant. The only element that appeared in abnormally large quantities at five lick waters was fluorine, which exceeded 6 p.p.m. Since these natural licks were utilized only during the

spring and early summer, the effects that fluoride may have on the health of big game was not determined. Dispersal of elk from natural licks by placing salt blocks in the vicinity was effective only as long as the salt blocks were present.

Salt grounds established for cattle were used considerably by elk when cattle were not present. Salt placed on summer range did not induce elk to remain longer or to leave winter range earlier. No significant differences could be detected in the rate of elk movements to higher elevations from the winter range between salted and unsalted portions of the study area.

Bur. Sport Fisheries & Wildlife, U. Idaho, Moscow, Idaho. 83843

331. Dalke, P. D., Beeman, R. D., Kindel, F. J., Robel, R. J., and Williams, T. R. SEASONAL MOVEMENTS OF ELK IN THE SELWAY RIVER DRAINAGE, IDAHO. J. Wildlife Mangt. 29(2): 333-338. 1965.

Seasonal movements of Rocky Mountain elk (Cervus canadensis) in the lower 35 miles of the Selway River drainage in Idaho were ascertained by pellet-group counts and 38 aerial surveys over a period of 4 years. Elk followed the retreating snow line but descended to the lower slopes with the first appearance of new growth of grasses, sedges, and forbs. Following this distinct downward trend in April, elk gradually worked upward to the summer range. The advent of herbaceous spring vegetation had a greater effect on elk movements than did artificial salt during April and May.

Because of the steep topography of the Selway country, migrations from high mountain meadows to winter range did not exceed 20 miles, and for many elk the distance would not be more than 8 or 10 miles. Fall movements of elk occurred not only from higher to lower elevations, but laterally along the lower slopes of the Selway River--both upstream and downstream. On 10 of 25 northside drainages, these fall and winter movements caused concentrations of elk which reached 9.1 animals per 100 acres on some winter ranges.

U.S. Bur. Sport Fisheries & Wildlife, U. Idaho, Moscow, Idaho 83843

332. Holmes, A. C. V., and Sanderson, G. C. POPULATIONS AND MOVEMENTS OF OPOSSUMS IN EAST-CENTRAL ILLINOIS. J. Wildlife Mangt. 29(2): 287-295. 1965.

Four hundred and forty-six opossums (Didelphis marsupialis) were livetrapped and marked in an area of about 2.8 square miles of uncultivated land in east-central Illinois. In this favorable habitat, the estimated population at midsummer was about 300 opossums per square mile. Sex ratios were apparently about even, although adult males were caught relatively less frequently than females and young. Seventy-five percent of the adult females examined had pouch young at some time during the year. The average number of young per litter was 7.9. Some females had two litters in one season. The average distance between capture site and center of activity was determined for each of 74 opossums; the mean of these averages was 697 feet. Distances between captures in live traps on successive nights were measured for 41 opossums; the average of the 77 distances was 748 feet. Both methods of estimating relative mobility indicated that adult males were much more mobile than adult females and juveniles. One of the two opossums tracked by radio did not appear to have a well-established home range, but radio-tracking data from the second one corroborated the previously collected trapping data.

Ill. Nat. Hist. Survey, Urbana, Ill. 61803

333. Harper, J. A., and Lavisky, R. F. THE INFLUENCE OF CALCIUM ON THE DISTRIBUTION OF PHEASANTS IN ILLINOIS. J. Wildlife Mangt. 28(4): 722-731. 1964.

The role of deficient calcium as a factor limiting the distribution of pheasants (Phasianus colchicus) in Illinois was investigated by comparing the availability of calcium and its subsequent ingestion by wild pheasants on an area (Neoga) of old glacial till originating from the Illinoian glacial age and on an area (Sibley) of more recent till originating from the Wisconsin glacial age. The amount of calcitic grit and the amount of calcium contained in the calcitic grit, collected from roads and agricultural fields on both areas, were similar, as were the amounts of calcium found in the soils from the two areas. The amounts of calcium found in the grit from

gizzards of hens and young from both areas were very similar. The number and hatchability of eggs per incubated clutch, the production of chicks per hen, and the ash content of femora and of entire carcasses of hens during the nesting season were similar among pheasants at both Neoga and Sibley.

Wild pheasants, particularly hens and young, seemingly possess the ability to select: (1) Calcareous grit from non-calcareous grit; (2) calcitic grit from dolomitic grit; and (3) calcitic grit with a high-calcium content from that with a low-calcium content; this habit of selective calcium ingestion may allow pheasants to prosper on areas where calcareous grit is found only in relatively small quantities. The availability of calcium and its subsequent ingestion by pheasants at Neoga, an area of old glacial till, were apparently adequate for the establishment of self-maintaining pheasant populations.

Oreg. State Game Comm., Corvallis, Oreg.

334. Burger, G. V. SURVIVAL OF RING-NECKED PHEASANTS RELEASED ON A WISCONSIN SHOOTING PRESERVE. J. Wildlife Mangt. 28(4): 711-721. 1964.

Of 2,386 banded ring-necked pheasants (Phasianus colchicus) released under the gun and shot on a private, 1,942-acre shooting preserve in southeastern Wisconsin, 84 percent were bagged less than one-fourth mile and 95 percent less than 1 mile from their release sites. Preserve hunters harvested 50 percent of 5,441 pheasants stocked during 3 years. Each spring, about 6 percent of the releases apparently survived on the preserve, and 2 percent off the area, within 2 miles of the release sites.

Of 93 birds bagged by outside hunters within 1.5 miles of the release area, 20 percent were preserve releases.

In 3 years, 702 dead pheasants were found on the preserve. Length of time between release and death was fixed for 220 remains; 65 percent had died within 1 week of release. A calculated disappearance rate showed a total hunting loss, plus nonhunting losses of the first 2 weeks after release, of 83 percent. The rate of loss to nonhunting factors declined after 12 weeks to a stable biweekly rate which, if projected, resulted in a total annual loss of 54 percent. Of 226 known-cause deaths, release shock was blamed for 28 percent and shot wounds and predation for 29 and 42 percent, respectively. Feral cats (Felis domestica), Cooper's hawks (Accipiter cooperii), and foxes (Vulpes fulva and Urocyon cinereoargenteus) were major predators. Concentrations of newly released, pen-reared birds probably aggravated predation. Total nonhunting mortality was not fixed, but apparently was responsible, rather than egress, for the postrelease disappearance of most pheasants.

Dept. Wildlife Mangt., U. Wis., Madison, Wis. 53706

335. Robel, R. J. DIFFERENTIAL WINTER MORTALITY OF BOBWHITES IN KANSAS. J. Wildlife Mangt. 29(2): 261-266. 1965.

During a 1961-64 study of bobwhites (Colinus virginianus) in northeastern Kansas, 261 were collected in an effort to obtain information on food habits, incidence of internal parasites, and population dynamics. Some of the information on population dynamics was presented. The data were stratified into two periods, autumn and winter.

The proportion of adults in the population increased as the quail entered the severe winter months. This change in age ratio served as a basis for determining differential mortality between juveniles and adults. Survival rate of juveniles during the September-through-April period was calculated to be 0.271 of the survival rate of adults for the same period. In contrast to most other studies, unbalanced sex ratios favored the females during this study. Females accounted for 53.26 percent of the quail collected, being slightly more numerous in samples during the autumn period. No differential mortality was detected between males and females.

Agr. Expt. Sta., Kans. State U., Manhattan, Kans. 66504

336. Scott, D. F. REFORESTATION AND QUAIL MANAGEMENT AT FORT CAMPBELL, KENTUCKY. Trans. North Amer. Wildlife and Natural Resources. Conf. 29: 281-286. 1964.

The effects were discussed of reforestation and site preparation on quail harvest over a 10-year period. The author concluded that: (1) The quail harvest on reforested areas did not decline greatly until 7 to 8 years after planting. At this time the harvest per thousand acres declines rapidly. and (2) mechanical site preparation prior to reforestation greatly improved quail habitat. The increased production for a few years afterwards helped to balance out years of low productivity which will occur as the planted plantations grow larger.

It is readily apparent that at least minor modifications in reforestation techniques must be made to maintain some habitat which will produce huntable populations of quail. The economical benefits derived from pine plantations usually cause the production of wood fiber to be placed at a higher level than the production of quail. By the skillful application of various land management tools such as prescribed burning, mechanical site preparation, and harvesting methods, the forester or land manager can produce maximum fiber along with huntable populations of quail.

Post Forester, Off. Post Engin., Fort Campbell, Ky. 42223

337. Caldwell, L. D. DOVE PRODUCTION AND NEST SITE SELECTION IN SOUTHERN MICHIGAN. J. Wildlife Managt. 28(4): 732-738. 1964.

Mourning dove (Zenaidura macroura) nesting was studied in Michigan on two sites-- 514 and 32 acres. Vegetation available for nest sites was measured quantitatively and its use by doves analyzed. Doves exhibited a definite site preference for certain tree species like red pine (Pinus resinosa) and Norway spruce (Picea abies), and habitat types such as the conifer and medium shrub categories: White pine (Pinus strobus) and Scotch pine (P. sylvestris) were not used. Habitat type did not seem to affect nesting success. Forty-one pairs nested on the larger area and four pairs on the smaller area. Four marked pairs renested with their original mates.

Out of 164 attempted nesting on both areas, there were 58 (35 percent) successful nestings. The percentage of successful nests varied little between the areas, being 36 percent on the larger and 33 percent on the smaller property. A marked difference, however, was exhibited between relative percentages of eggs hatched (70 percent on the larger area, 35 percent on the smaller) and nestlings fledged (46 percent and 83 percent, respectively). The number of young fledged per adult pair was estimated to be 2.2 on the larger nest-trapped area and 2.5 on the smaller untrapped area. These figures were lower than the average dove production rates recorded in the literature and were sufficient to replace population losses only if the annual turnover was as low as 53 percent.

Central Mich. U., Mt. Pleasant, Mich. 48858

Soil Conserv. 30(4): 75-96. Nov. 1964.

This issue of Soil Conservation was devoted principally to Nature Conservation and Conservation Education. The following articles were given:

338. Myers, R. E., and Stennett, H. E. WATERSHED WILDLIFE: ISCHUA CREEK SHOWS HOW LOCAL PEOPLE CAN PROVIDE WIDESPREAD HABITAT. SCS, USDA, Syracuse, N.Y.
339. Smith, H. G. SPOILBANKS AND BIRDLIFE: BIRDS COME BACK TO AVONDALE WITH RECOVERY OF VEGETATION ON RECLAIMED STRIP MINES. SCS, USDA, Columbus, Ohio.
340. Anonymous. GHOST RANGE MUSEUM: NATURAL AREAS, CONSERVATION EXHIBITS ARE LIVING TEXTBOOK OF THE LAND.
341. Clausen, E. W. OUTDOOR LABORATORY BUILDS INTEREST IN ALL STUDIES. Supt. Schools, Freehold, N.J. 07728
342. Anonymous. CONSERVATION, YOUR COMMUNITY, AND YOU: SCOUT JAMBOREE THEME TOLD TO 50,000 BOYS IN MULTIPLE RESOURCE EXHIBIT AREAS.

343. Edminster, F. C. QUALITY IN OUTDOOR RECREATION. SCS, USDA, Washington, D.C. 20250
344. Grizzell, R. A., and Davison, V. E. HERE'S HOW TO--ATTRACT BIRDS AND OTHER WILDLIFE TO RURAL AREAS. SCS, USDA, Little Rock, Ark.
345. Anonymous. GRAVITY FLOW SPRINKLER SYSTEM FOR FOOTHILL IRRIGATION.
346. Vosburgh, J. NATURAL HISTORY SOCIETIES: NATIONAL AUBUBON SOCIETY SERVES GROWING INTEREST IN NATURE. Ed. Audubon Mag.
347. Briggs, S. A. NATURAL HISTORY SOCIETIES: REGIONAL, LOCAL GROUPS HAVE DIVERSE PROGRAMS. Ed., Atlantic Naturalist.
348. Williams, D. A. CIVIL RIGHTS ACT; RURAL BEAUTY. SCS, USDA, Washington, D.C. 20250

Wetland Wildlife

See Also 45, 46, 342.

349. Galtsoff, P. S. THE AMERICAN OYSTER (*CRASSOSTREA VIRGINICA* GMELIN.) U.S. Dept. Int., Fish and Wildlife Serv. Fisheries B. 64, 480 pp. \$2.75. 1964.

The book of American oysters (*Crassostrea virginica*) of the Atlantic and Gulf States was written for those interested to learn about the life history and mode of living of this species. Trying to be scientifically accurate and at the same time to make the text understandable to those who have only elementary knowledge of biological sciences, an attempt was made to present the facts and discuss various theories in the simplest language. Various techniques used in anatomical, historical, and physiological studies were described in detail.

Each of the 18 chapters comprising the book can be read independently of others. Selected bibliographical references accompanied each chapter.

For Sale by Supt. Doc., U.S. Govt. Print. Off., Washington, D.C. 20402

350. Amer, D. H. RESEARCH AND A PRACTICAL APPROACH NEEDED IN MANAGEMENT OF BEAVER AND BEAVER HABITAT IN THE SOUTHEASTERN UNITED STATES. Trans. North Amer. Wildlife and Natural Resources Conf. 29: 150-158. 1964.

Future research work concerning the widespread activities of the beaver should have a twofold purpose; (1) To determine how to best protect the timber-land owner from excessive beaver damage; and (2) to determine how to preserve and utilize the extensive acreage of shallow water beaver impoundments for the benefit of waterfowl.

The first aspect, that of forest land protection, should involve the following studies: (1) Oral contraceptives should be tested to determine their ability to control expanding beaver populations; (2) some of the new chemical repellents should be thoroughly tested to see if these repellents would be economically feasible to make nuisance beaver move out of certain areas; (3) investigations should also be made concerning the improvement of trapping, skinning, and marketing techniques; and (4) the study of the use of drains should be expanded and should cover the entire growing season of trees.

The second aspect, that concerning how to best utilize the large acreage of shallow water beaver ponds for the benefit of waterfowl, should involve the following: (1) Field trial testing of different plants, such as new Japanese millet varieties; (2) studying the effect of annual draw downs on fish populations in beaver ponds; (3) investigating as to whether an increased food supply will hold native wood ducks longer in the fall; and (4) determining whether an increased food supply would attract wood ducks to nest in the immediate vicinity of the plantings.

If only 25 percent of the 10,000 acres of beaver flooded land in five Alabama counties was leased and developed to grow Japanese millet, over 125,000 ducks in these 5 counties could be fed well for the 4 winter months.

Miss. State U., State College, Miss. 39762

Problems Indirectly Affecting the Application of

Soil and Water Conservation Practices

See Also 45, 46, 109, 110, 134, 168-171, 186, 191, 229, 238, 243, 244, 269, 272, 279, 280, 281, 287, 295-297, 320, 323, 325.

351. Wicks, G. A., and Burnside, O. C. RESIDUES IN SOIL ONE YEAR AFTER HERBICIDES WERE APPLIED TO SORGHUM. Weeds 13(2): 173-175. Apr. 1965.

Atrazine and propazine affected oats and alfalfa in Nebraska planted the year following application to sorghum. No carry-over of CDAA + TCBC was detected in oats and alfalfa. Intertillage of sorghum did not decrease herbicide residue.

North Platte Expt. Sta., North Platte, Nebr. 69101

352. Wax, L. M., and Behrens, R. ABSORPTION AND TRANSLOCATION OF ATRAZINE IN QUACKGRASS. Weeds 13(2): 107-109. Apr. 1965.

The effect of temperature and relative humidity on root and foliar uptake of C-14 labeled atrazine in quackgrass (Agropyron repens (L.) Beauv.) was studied in a controlled environment growth chamber. Uptake and translocation of root-fed atrazine increased as temperature increased. Greater uptake and translocation of root-fed atrazine occurred under low relative humidity than under high relative humidity. Slightly greater uptake and translocation of foliar-applied atrazine occurred as temperature was increased from 60° to 80° F.

Crops Div., U.S. Army Biol. Lab., Fort Detrick, Md.

353. Erickson, L. C. THE MOVEMENT AND PHYTOTOXICITY OF MONURON IN PALOUSE SILT LOAM SOIL. Weeds 13(2): 100-102. Apr. 1965.

Canada thistle (Cirsium arvense (L.) Scop.) infestations were treated with monuron at 10 rates ranging from 5 to 160 lb./A. Depths to which monuron leached were determined annually by bioassays with flax, peas, and wheat. Toxicity at all rates continued for 3 years. The low sand, high clay, and high organic matter contents of this soil combined with cool or dry climatic conditions inhibited leaching and prolonged the toxicity of monuron.

Agr. Expt. Sta., U. Idaho, Moscow, Idaho. 83843

354. Neubauer, L. W., and Sullivan, J. J. RELATION OF HEAVY CHEMICAL TREATMENT TO DURABILITY OF WOOD IN GROUND CONTACT. Trans. ASAE 8(2): 238-240, 243. 1965.

The following conclusions were made from varied durability tests during the 39-year period on the effect of heavy chemical treatment to the durability of wood at the contact of the ground:

1. Durability of natural woods set in the ground varied from 1.5 to 17 years. Cedar and redwood were the most durable.
2. Any and all chemical treatments used were of some value in extending the durable life.
3. Increased durability varied almost directly with the amount of treatment absorbed.
4. Heavily treated posts were expected to have an average life of up to 74 years.
5. Several chemicals, including creosote, pentachlorophenol, Columbia, zinc chloride, and chemonite, proved very effective.
6. Decay and termites were found to occur both separately and in combination.
7. Incising was apparently of little or no value.

8. End coating proved to be satisfactory, providing normal durability with decreased absorption.

U. Calif., Davis, Calif. 95616

355. Ray, M. L., and Child, R. D. WINTERING STEERS ON BROILER HOUSE LITTER. Ark. Farm Res. 8(5): 3. 1964.

Broiler house litter and 12 percent protein-level rice hulls were compared as the only source of roughage in wintering rations for beef steer calves.

The litter used had a rice hull base.

The study was divided into two phases of 70 days (phase I) and 84 days (phase II). In phase I, 2.25 percent animal fat was added to the broiler house litter in an attempt to minimize dustiness. In phase II, 5 percent dried molasses was added to both roughages to reduce dustiness and to increase palatability and voluntary feed intake.

Average feed required per pound of gain remained approximately the same for the broiler house litter group in phases I and II. In this group, 20.3 and 20.9 pounds of feed were required to produce a pound of gain in phases I and II, respectively. However, in the rice hull group, 16.2 and 30.2 pounds of the ration were required to produce a pound of gain in phases I and II.

Results of the entire test period are given in the table. It would appear that broiler house litter will produce satisfactory wintering gains when fed as roughage to steer calves.

Table. Results of Entire Trial

Measure	Litter	Rice hulls
No. steers	8	8
Av. initial wt. (#)	432	431
Av. final wt. (#)	529	523
Av. gain (#)	97	92
Av. daily gain (#)	0.63	0.60
Total cost per day	18.4¢	24.8¢

Agr. Expt. Sta., U. Ark., Fayetteville, Ark. 72701

Radioactive Fallout

See Also 70.

356. Rickard, W. H. FIELD OBSERVATIONS ON FALLOUT ACCUMULATION BY PLANTS IN NATURAL HABITATS. J. Range Mangt. 18(3): 112-114. 1965.

Fallout accumulation by aboveground plant parts was related to differences in leaf and twig structure and time organs were exposed to atmosphere. Trees appeared to lessen fallout accumulation by understory shrubs.

Biol. Dept., Battelle-Northwest, Richland, Wash. 99352

357. Evans, E. J., and Dekker, A. J. FOLIAR, FLORAL, AND ROOT ABSORPTION OF Sr-90 BY CROPS. Agron. J. 57(1): 82-83. 1965.

A field experiment was carried out to determine the relative Sr-90 content of wheat, oats, alfalfa, and timothy grown in the open compared with that of the same crops grown under clear plastic tents. Wheat was also grown under cover from the flowering stage to maturity. Samples of wheat were milled and the Sr-90 contents of the different fractions were determined.

Direct absorption of Sr-90 by aboveground parts of the plants exceeded root absorption for all crops. Less difference was found between the two modes of absorption for the second cutting of alfalfa than for the other crops. This was explained on the basis of rainfall and length of growing season.

The Sr-90 content of flour, and bran milled from wheat grown in the open was considerably greater than that of the same fractions milled from wheat which was covered at the flowering stage. The ratios of Sr-90 in flour to that in bran were, however, similar in the two situations.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Ontario, Canada.

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